

AD-A066 981

SYSTEMS AND APPLIED SCIENCES CORP RIVERDALE MD

F/6 4/2

SYNOPTIC ANALYSIS CASE 3, 23 FEBRUARY 1977 - 25 FEBRUARY 1977.(U)

JAN 79 D CHIN, H D HAMILTON

F19628-78-C-0138

UNCLASSIFIED

SCIENTIFIC-3

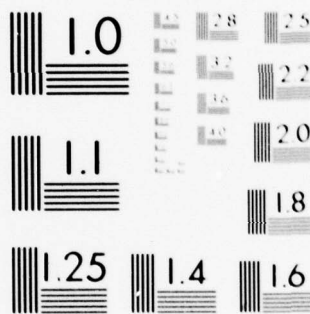
AFGL-TR-79-0021

NL

1 OF 2

AD
A066981





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AFGL-TR-79-0021

LEVEL

1065555

12

AD A0 66981

SYNOPTIC ANALYSIS CASE 3
23 FEBRUARY 1977 - 25 FEBRUARY 1977

Don Chin
Harry D. Hamilton

SYSTEMS AND APPLIED SCIENCES CORPORATION
6811 Kenilworth Avenue
Suite 610
Riverdale, Maryland 20840



Scientific Report No. 3

18 January 1979

Approved for public release; distribution unlimited.

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

79 04 05 004

DDC FILE COPY

Qualified requestors may obtain additional copies from the Defense Documentation Center. All others should apply to the National Technical Information Service.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
(18) AFGL-TR-79-0021	(19) TR-79-0021		
4. TITLE (and Subtitle)		5. TYPE OF REPORT & PERIOD COVERED	
(6) SYNOPSIS ANALYSIS CASE 3, 23 FEBRUARY 1977 - 25 FEBRUARY 1977.		SCIENTIFIC REPORT NO. 3	
7. AUTHOR(s)		6. PERFORMING ORG. REPORT NUMBER	
(10) Don Chin Harry D. Hamilton			
8. CONTRACT OR GRANT NUMBER(s)		(15) F19628-78-C-0138	
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
SYSTEMS AND APPLIED SCIENCES CORPORATION 6811 Kenilworth Ave., Suite 610 Riverdale, Maryland 20840		(16) 61102F 2310G5AA (17) 65	
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE	
Air Force Geophysics Laboratory Hanscom AFB, Massachusetts 01731 Manager/Leandro Delgado, Capt/LYC		(11) 18 January 1979	
13. NUMBER OF PAGES		15. SECURITY CLASS. (of this report)	
(12) 104 p.		105 UNCLASSIFIED	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report)			
Approved for public release; distribution unlimited.			
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
(14) SCIENTIFIC-3			
18. SUPPLEMENTARY NOTES			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)			
SYNOPTIC ANALYSIS METEOROLOGY WEATHER GEOPHYSICS			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)			
<p>The synoptic scale weather conditions over the continental United States for the period 23-25 February 1977 are documented in support of the Large Scale Cloud Systems Program. Included in this report are the flight tracks of the research aircraft, a narrative description, and analyses of meteorological parameters from the surface to 200 mb.</p> <p>393 846</p>			

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ACKNOWLEDGEMENT

The authors wish to acknowledge the assistance of Dr. Arnold Barnes and Captain Leandro Delgado, USAF, of the Air Force Geophysics Laboratory for their technical direction and valuable suggestions. The authors are also appreciative of the graphical and clerical expertise of Mr. Michael Welch and Ms. Christine McCoy.

ACCESSION for	
NTIS	Write Section <input checked="" type="checkbox"/>
DOC	Bull Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
DI	CIAL
A	

PRECEDING PAGE BLANK

P R E F A C E

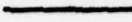




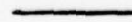
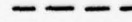
This report is one of a series of similar reports which document the synoptic scale meteorological conditions over the continental United States for a specified period. During each period, one or more flights were conducted by research aircraft in support of the Large Scale Cloud Systems Program. Each flight consists of several legs.

An overall synoptic summary for the entire period is provided at the beginning of each report. Following the summary are sections covering the individual flights. Each section contains the following for a given flight:

- aircraft track for each leg of the flight
- narrative summary of the local weather conditions
- surface analyses and nephanalyses at standard six-hourly synoptic times
- upper air analyses at the 850, 700, 500 and 300 mb levels at standard twelve-hourly synoptic times. (The 200 mb level is included for those series during which research flights were conducted above 300 mbs.)
- 500 mb vertical motion and vorticity patterns at standard twelve-hourly synoptic times
- local area surface analyses at standard three-hourly intervals bracketing the period of each flight
- vertical cross-sections along the flight path for each leg of a flight.

For clarity, no more than two sets of isolines are shown on the upper air charts. All heights are given in geopotential meters above mean sea level (MSL) unless designated otherwise.





The legends for the various charts are given as follows:

<u>CHART</u>	<u>LEGEND</u>
Surface Analysis	 Pressure (millibars) - only the last 2 digits are given  Flight Area (applies to all charts) Fronts, Highs, Lows, Troughs, etc. are depicted according to standard conventions.
Nephanalysis	C Covered (80-100% cloud cover) MCO Mostly Covered (50-80% cloud cover) MOP Mostly Open (20-50% cloud cover) O Open (0-20% cloud cover)  Boundary delineating Covered areas  Boundary delineating Mostly Covered areas  Boundary delineating Mostly Open areas Cb Cumulonimbus Ci Cirriform Cu Cumuloform St Stratiiform Sc Stratocumulus In the above boundaries, the "bumps" point toward areas of lower cloud amounts. Surface Highs, Lows, Fronts, etc., are also depicted on this chart according to standard conventions.
Upper Air Analysis	 Heights (tens of meters) - only 3 digits are given.  Isotachs (meters/second) MAX Isotach Maximum MIN Isotach Minimum




CHART

LEGEND

Upper Air Analysis (cont'd)

	Temperature (degrees Celsius)
	Dew Point Depression (degrees Celsius)
M	Area of relatively moist air
D	Area of relatively dry air
	Vertical Velocity (microbars/second)
+	Upward motion
-	Downward motion
	Vorticity (10^{-5} per second)

Local Surface Analysis

	Pressure (millibars) - only last 2 digits given
	Flight Area
	Precipitation Area

Vertical Cross-Section









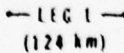
	Half barb = 2.5 meters/second
	Full barb = 5.0 meters/second
	Flag = 25 meters/second
	Temperature (degrees Celsius)
	Dew Point Depression (degrees Celsius)
	Cloud depiction (tops)
	Cloud depiction (bottoms)
	Terrain
	Flight Path - leg number (distance in kilometers)

TABLE OF CONTENTS

	PAGE
SECTION 1. SYNOPSIS SUMMARY 23-25 FEBRUARY 1977	9
1.1 Upper Circulation	9
1.2 Surface Pattern	9
SECTION 2. FLIGHT 1 23 FEBRUARY 1977	11
2.1 Aircraft Tracks	11
2.2 Local Synoptic Summary	11
SECTION 3. FLIGHT 2 24 FEBRUARY 1977	54
3.1 Aircraft Tracks	54
3.2 Local Synoptic Summary	54

LIST OF ILLUSTRATIONS

PAGE

FLIGHT 1

FIGURE	1.	SURFACE PRESSURE - - - - -	23 FEB 77 12Z ANALYSIS . .	16
	2.	SURFACE PRESSURE - - - - -	23 FEB 77 18Z ANALYSIS . .	17
	3.	SURFACE PRESSURE - - - - -	24 FEB 77 00Z ANALYSIS . .	18
	4.	NEPHANALYSIS - - - - -	23 FEB 77 12Z	19
	5.	NEPHANALYSIS - - - - -	23 FEB 77 18Z	20
	6.	NEPHANALYSIS - - - - -	24 FEB 77 00Z	21
	7.	850 mb HEIGHTS/ISOTACHS - - - - -	23 FEB 77 12Z ANALYSIS . .	22
	8.	850 mb TEMP./DEW PT. DEPRESSION -	23 FEB 77 12Z ANALYSIS . .	23
	9.	850 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 00Z ANALYSIS . .	24
	10.	850 mb TEMP./DEW PT. DEPRESSION -	24 FEB 77 00Z ANALYSIS . .	25
	11.	700 mb HEIGHTS/ISOTACHS - - - - -	23 FEB 77 12Z ANALYSIS . .	26
	12.	700 mb TEMP./DEW PT. DEPRESSION -	23 FEB 77 12Z ANALYSIS . .	27
	13.	700 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 00Z ANALYSIS . .	28
	14.	700 mb TEMP./DEW PT. DEPRESSION -	24 FEB 77 00Z ANALYSIS . .	29
	15.	500 mb HEIGHTS/ISOTACHS - - - - -	23 FEB 77 12Z ANALYSIS . .	30
	16.	500 mb TEMP./DEW PT. DEPRESSION -	23 FEB 77 12Z ANALYSIS . .	31
	17.	500 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 00Z ANALYSIS . .	32
	18.	500 mb TEMP./DEW PT. DEPRESSION -	24 FEB 77 00Z ANALYSIS . .	33
	19.	500 mb VERT. VELOCITY/VORTICITY -	23 FEB 77 12Z ANALYSIS . .	34
	20.	500 mb VERT. VELOCITY/VORTICITY -	24 FEB 77 00Z ANALYSIS . .	35
	21.	300 mb HEIGHTS/ISOTACHS - - - - -	23 FEB 77 12Z ANALYSIS . .	36
	22.	300 mb TEMPERATURE - - - - -	23 FEB 77 12Z ANALYSIS . .	37
	23.	300 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 00Z ANALYSIS . .	38

LIST OF ILLUSTRATIONS (cont.)

PAGE

FIGURE 24.	300 mb TEMPERATURE - - - - -	24 FEB 77 00Z ANALYSIS . .	39
25.	200 mb HEIGHTS/ISOTACHS - - - - -	23 FEB 77 12Z ANALYSIS . .	40
26.	200 mb TEMPERATURE - - - - -	23 FEB 77 12Z ANALYSIS . .	41
27.	200 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 00Z ANALYSIS . .	42
28.	200 mb TEMPERATURE - - - - -	24 FEB 77 00Z ANALYSIS . .	43
29.	LOCAL SURFACE PRESSURE - - - - -	23 FEB 77 18Z ANALYSIS . .	44
30.	LOCAL SURFACE PRESSURE - - - - -	23 FEB 77 21Z ANALYSIS . .	45
31.	LOCAL SURFACE PRESSURE - - - - -	24 FEB 77 00Z ANALYSIS . .	46
32.	WIND CROSS-SECTION - - - - -		
	LEG 1 - - - - -	23 FEB 77 ANALYSIS	48
33.	TEMP./DEW PT. DEPRESSION - - - - -		
	CROSS-SECTION, LEG 1 - - - - -	23 FEB 77 ANALYSIS	49
34.	WIND CROSS-SECTION - - - - -		
	LEGS 2, 3, AND 4 - - - - -	23 FEB 77 ANALYSIS	50
35.	TEMP./DEW PT. DEPRESSION - - - - -		
	CROSS-SECTION, LEGS 2, 3, AND 4 - - - - -	23 FEB 77 ANALYSIS	51
36.	WIND CROSS-SECTION - - - - -		
	LEGS 5 AND 6 - - - - -	23 FEB 77 ANALYSIS	52
37.	TEMP./DEW PT. DEPRESSION - - - - -		
	CROSS-SECTION, LEGS 5 AND 6 - - - - -	23 FEB 77 ANALYSIS	53

FLIGHT 2

FIGURE 38.	SURFACE PRESSURE - - - - -	24 FEB 77 06Z ANALYSIS . .	60
39.	SURFACE PRESSURE - - - - -	24 FEB 77 12Z ANALYSIS . .	61
40.	SURFACE PRESSURE - - - - -	24 FEB 77 18Z ANALYSIS . .	62
41.	SURFACE PRESSURE - - - - -	25 FEB 77 00Z ANALYSIS . .	63
42.	NEPHANALYSIS - - - - -	24 FEB 77 06Z ANALYSIS . .	64

LIST OF ILLUSTRATIONS (cont.)

PAGE

FIGURE 43.	NEPHANALYSIS - - - - -	24 FEB 77 12Z ANALYSIS . .	65
44.	NEPHANALYSIS - - - - -	24 FEB 77 18Z ANALYSIS . .	66
45.	NEPHANALYSIS - - - - -	25 FEB 77 00Z ANALYSIS . .	67
46.	850 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 12Z ANALYSIS . .	68
47.	850 mb TEMP./DEW PT. DEPRESSION -	24 FEB 77 12Z ANALYSIS . .	69
48.	850 mb HEIGHTS/ISOTACHS - - - - -	25 FEB 77 00Z ANALYSIS . .	70
49.	850 mb TEMP./DEW PT. DEPRESSION -	25 FEB 77 00Z ANALYSIS . .	71
50.	700 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 12Z ANALYSIS . .	72
51.	700 mb TEMP./DEW PT. DEPRESSION -	24 FEB 77 12Z ANALYSIS . .	73
52.	700 mb HEIGHTS/ISOTACHS - - - - -	25 FEB 77 00Z ANALYSIS . .	74
53.	700 mb TEMP./DEW PT. DEPRESSION -	25 FEB 77 00Z ANALYSIS . .	75
54.	500 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 12Z ANALYSIS . .	76
55.	500 mb TEMP./DEW PT. DEPRESSION -	24 FEB 77 12Z ANALYSIS . .	77
56.	500 mb HEIGHTS/ISOTACHS - - - - -	25 FEB 77 00Z ANALYSIS . .	78
57.	500 mb TEMP./DEW PT. DEPRESSION -	25 FEB 77 00Z ANALYSIS . .	79
58.	500 mb VERT. VELOCITY/VORTICITY -	24 FEB 77 12Z ANALYSIS . .	80
59.	500 mb VERT. VELOCITY/VORTICITY -	25 FEB 77 00Z ANALYSIS . .	81
60.	300 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 12Z ANALYSIS . .	82
61.	300 mb TEMPERATURE - - - - -	24 FEB 77 12Z ANALYSIS . .	83
62.	300 mb HEIGHTS/ISOTACHS - - - - -	25 FEB 77 00Z ANALYSIS . .	84
63.	300 mb TEMPERATURE - - - - -	25 FEB 77 00Z ANALYSIS . .	85
64.	200 mb HEIGHTS/ISOTACHS - - - - -	24 FEB 77 12Z ANALYSIS . .	86
65.	200 mb TEMPERATURE - - - - -	24 FEB 77 12Z ANALYSIS . .	87
66.	200 mb HEIGHTS/ISOTACHS - - - - -	25 FEB 77 00Z ANALYSIS . .	88

	LIST OF ILLUSTRATIONS (cont.)	PAGE
FIGURE 67.	200 mb TEMPERATURE - - - - - 25 FEB 77 00Z ANALYSIS . .	89
68.	LOCAL SURFACE PRESSURE - - - - - 24 FEB 77 18Z ANALYSIS . .	90
69.	LOCAL SURFACE PRESSURE - - - - - 24 FEB 77 21Z ANALYSIS . .	91
70.	LOCAL SURFACE PRESSURE - - - - - 25 FEB 77 00Z ANALYSIS . .	92
71.	WIND CROSS-SECTION - - - - - LEGS 1 AND 2 - - - - - 24 FEB 77 ANALYSIS	94
72.	TEMP./DEW PT. DEPRESSION - - - - - CROSS-SECTION, LEGS 1 AND 2 - 24 FEB 77 ANALYSIS	95
73.	WIND CROSS-SECTION - - - - - LEGS 3, 4, 5, AND 6 - - 24 FEB 77 ANALYSIS	96
74.	TEMP./DEW PT. DEPRESSION - - - - - CROSS-SECTION, LEGS 3, 4, 5, AND 6 - - - - - 24 FEB 77 ANALYSIS	97
75.	WIND CROSS-SECTION - - - - - LEGS 7, 8, 9, 10, AND 11-24 FEB 77 ANALYSIS	98
76.	TEMP./DEW PT. DEPRESSION - - - - - CROSS-SECTION, LEGS 7, 8, 9, 10, AND 11 - - - 24 FEB 77 ANALYSIS	99
77.	WIND CROSS-SECTION - - - - - LEGS 12 AND 13 - - - - - 24 FEB 77 ANALYSIS	100
78.	TEMP./DEW PT. DEPRESSION - - - - - CROSS-SECTION, LEGS 12 AND 13 - - - - - 24 FEB 77 ANALYSIS	101

	LIST OF TABLES	PAGE
TABLE 1.	AIRCRAFT TRACKS - - - - - 23 FEB 77	11
2.	AIRCRAFT TRACKS - - - - - 24 FEB 77	55

1. SYNOPTIC SUMMARY 23 - 25 FEBRUARY 1977

1.1 Upper Circulation. The dominant feature during the period of this report (from 1200Z 23 February through 0000Z 25 February 1977) is the long wave trough which lies over the central United States. A closed low is situated within the long wave trough up through 300 mb. During the 36 hours of this series, a short wave passes through the long wave trough, the low deepens gradually and moves slowly north-northeastward. At the beginning of the period a weak ridge lies over the Rocky Mountain region and another ridge is located off the Atlantic coast. As time progresses, the ridge over the Rockies flattens out while the ridge in the Atlantic increases in amplitude.

Moist air from the Pacific moves across the central West coast and extends over the Rocky Mountain area during the period. A broad area of moisture lies east and north of the low aloft, spreading eastward to the Atlantic coast as the period progresses.

The jet stream extends from California eastward through the Texas panhandle, swings around the low and passes over the Mississippi and Ohio Valley.

1.2 Surface Pattern. An extensive low in the central United States is the major surface system throughout the period. At the beginning of the period, the frontal system associated with this low has just occluded. As time progresses, the low moves northeastward and deepens. The frontal system occludes further as it pushes eastward.

Another low is located off the northern California coast at the start of the series. This low, and its associated frontal system, remains weak and moves through southern Nevada into the Texas panhandle by the end of the period.

2. FLIGHT 1 23 FEBRUARY 1977

2.1 Aircraft Tracks. The flight tracking data are given below in Table 1. The flight goes from Louisville, Kentucky to Chattanooga, Tennessee, then to Gadsden, Alabama. After two short legs south of Gadsden, the flight continues over Montgomery, Alabama and terminates at Eglin AFB, Florida. The terrain along the tracks is less than 330 meters in height except for the area over Tennessee, north of Chattanooga, where the terrain reaches 600 meters.

TABLE 1. AIRCRAFT TRACKS - 23 FEB 77

LEG	TIME (Z)		ALTITUDE ft (m)	POSITION		DISTANCE nm (km)
	START	STOP		BEGIN	END	
1	2100	2150	22,000 (6706)	LOU ¹	CHA ²	195 (361)
2	2150	2220	22,000 (6706)	CHA	GAD ³	77 (143)
3	2220	2228	5,000 (1524)	GAD	TAL ⁴	22 (41)
4	2228	2238	5,000 (1524)	TAL	21 nm S TAL	21 (39)
5	2238	2247	6,000 (1829)	21 nm S TAL	43 nm N MGM ⁵	18 (33)
6	2247	2337	6,000 (1829)	43 nm N MGM	VPS ⁶	154 (285)

¹LOU = Louisville, Kentucky (38°06'N 85°35'W)

²CHA = Chattanooga, Tennessee (34°58'N 85°09'W)

³GAD = Gadsden, Alabama (33°34'N 86°03'W)

⁴TAL = Talladega, Alabama (33°34'N 86°03'W)

⁵MGM = Montgomery, Alabama (32°13'N 86°19'W)

⁶VPS = Eglin AFB, Florida (30°29'N 86°32'W)

2.2 Local Synoptic Summary. At the surface, a 976 mb low is centered over southeast Nebraska at the beginning of the flight period. The flight tracks lie in the southerly flow to the southeast of the low. The cold front associated with this low is well to the west of the

flight area (Figure 1). As time progresses, the low moves slowly to the northeast. The associated frontal system becomes well occluded with the cold front advancing toward the flight area (Figures 2 and 3). Cloudiness increases from broken to overcast conditions as the cold front approaches the flight area. Stratiform layers thicken and cumuloform clouds become more numerous with thunderstorms developing as the cold front approaches the flight region (Figures 4 through 6).

The surface low extends upward through the 300 mb level. At 850 mb, the flight area is under the influence of south-southwesterly flow. An area of 35 meters per second (msec^{-1}) winds pass just to the west of the flight area during the flight period (Figures 7 and 9). Temperatures at 850 mb increase slightly as the flight progresses. An area of moist air extends over the flight tracks (Figures 8 and 10).

At 700 mb, the winds are from the southwest, becoming south-southwesterly as the low moves slowly toward the northeast and deepens. A wind maximum of 30 msec^{-1} passes to the west of the flight area during the flight period (Figures 11 and 13). Warm moist air in advance of the low extends over the flight tracks at the time of the flight (Figures 12 and 14).

The 500 mb level, as well as the adjacent levels, reflects a short wave trough passing through the long wave (as described in Section 1.1). The amplitude of the 500 mb trough increases, causing the winds over the flight area to shift from southwesterly to south-southwesterly over the flight period (Figures 15 and 17). An area of

40 msec⁻¹ winds approaches the flight tracks from the west, swings northward just to the west of the flight area, and increases in magnitude to 50 msec⁻¹. Warming occurs in advance of the 500 mb low while an area of moist air from the Gulf of Mexico passes over the flight tracks during the period (Figures 16 and 18). Upward vertical motion increases and positive vorticity is advected over the flight area (Figures 19 and 20).

The low at 300 mb deepens during the day of the flight. Winds at this level increase from 20-25 msec⁻¹ to 35 msec⁻¹ over the flight tracks during the twelve hour synoptic period (Figures 21 and 23). Temperatures over the flight region increase in advance of the low (Figures 22 and 24).

The closed low which exists at the lower levels is reflected as a trough at 200 mb. This trough intensifies, with winds over the flight tracks increasing from 30-35 msec⁻¹ to 35-40 msec⁻¹ during the day of the flight (Figures 25 and 27). Temperatures at 200 mb over the flight area increase as the trough approaches (Figures 26 and 28).

Prior to the commencement of the flight, the local surface chart (Figure 29) shows the flight area under the influence of southerly flow. Broken to overcast cloud conditions occur along the flight tracks with multiple cloud layers, scattered cumuloform clouds and rain showers. A broad band of rain and thunderstorm activity occurs to the west of the flight area in advance of the cold front which approaches from the west. During the progress of the flight, the precipitation band reaches the flight area (Figures 30 and 31). As

the flight progresses the thunderstorm and rainshower activity increases until the flight leaves the precipitation area during the last portion of the flight, between Montgomery, Alabama and Eglin AFB, Florida.

The flight cross-sections (Figures 32, 34, and 36) show southerly winds near the surface veering to southwesterly with height. Wind speeds along the flight track are generally greater than 25 msec^{-1} above 1 km except during the last hour of the flight, when the wind speeds diminish to 20 msec^{-1} below 2 km. The temperatures increase gradually at all levels as the flight proceeds southward (Figures 33, 35, and 37). A layer of moist air extends from 1.1 km to 8.5 km at the beginning of the flight track. By the end of the first leg, the base of the moist layer lifts to 1.7 km. At the end of the second leg, the base of the moist layer lowers to near the surface as shower activity increases. Numerous thunderstorms (not illustrated) increases the cloud tops to 9.0 km and higher. Toward the end of the flight, shower activity diminishes. The moist layer decreases in thickness and cloud bases lift to 800 meters. As the flight approaches the Gulf Coast near its destination, low stratiform clouds appear with bases near 100 meters. The freezing level is at 2.9 km at the beginning of the flight rising gradually to 3.3 km at the end of the flight.

A complex tropopause exists over the flight area during the period of the flight. The first stable layer begins at 11.0 km with temperatures of -52°C at the north end of the flight area decreasing to 9.9 km with temperatures of -46°C at the south end when the flight

terminates. The second stable layer (outside the bounds of the cross-sections) occurs between 70 and 79 mb with temperatures between -70°C and -73°C .

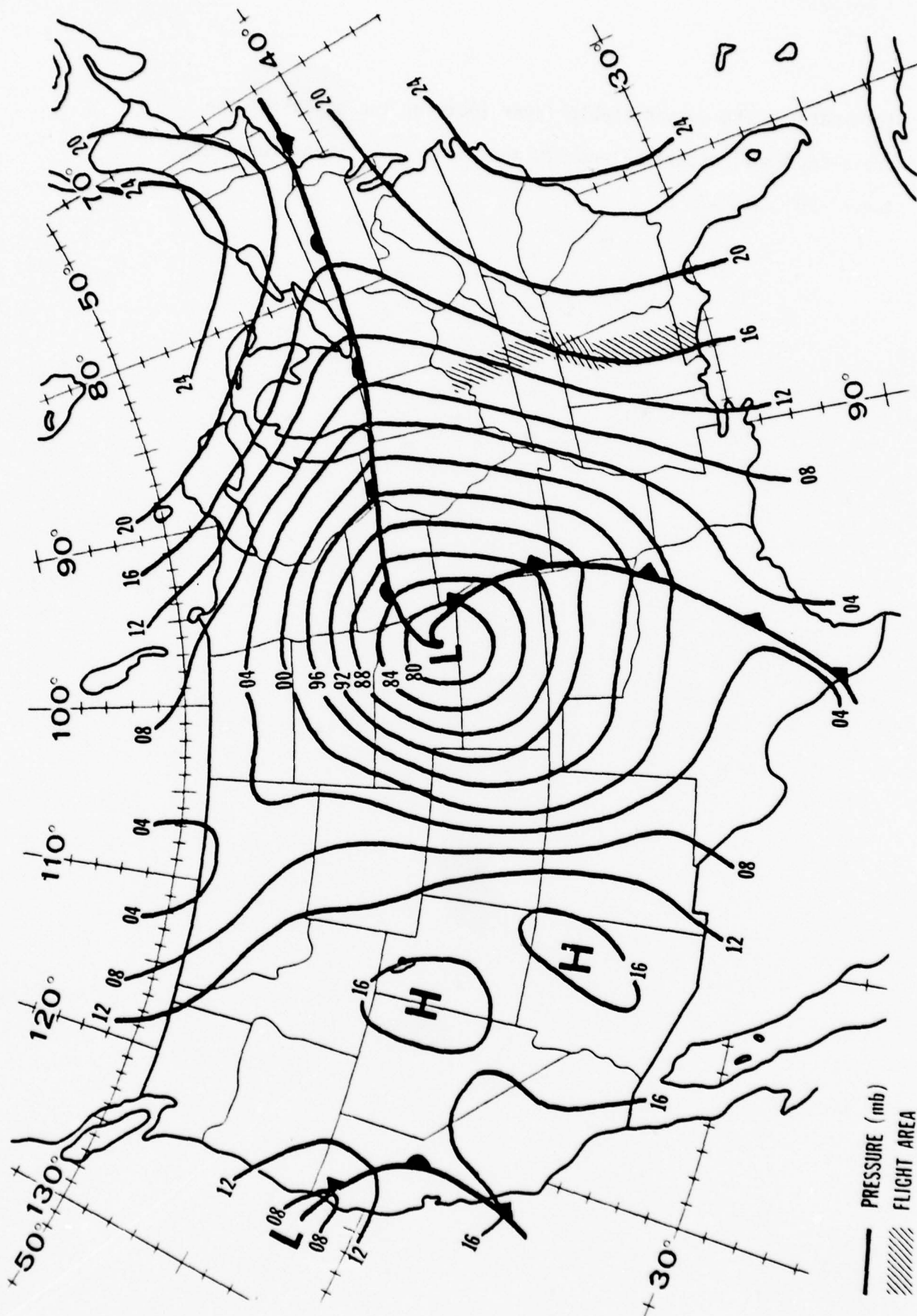


FIGURE 1. SURFACE PRESSURE - 23 FEB 77 12Z ANALYSIS

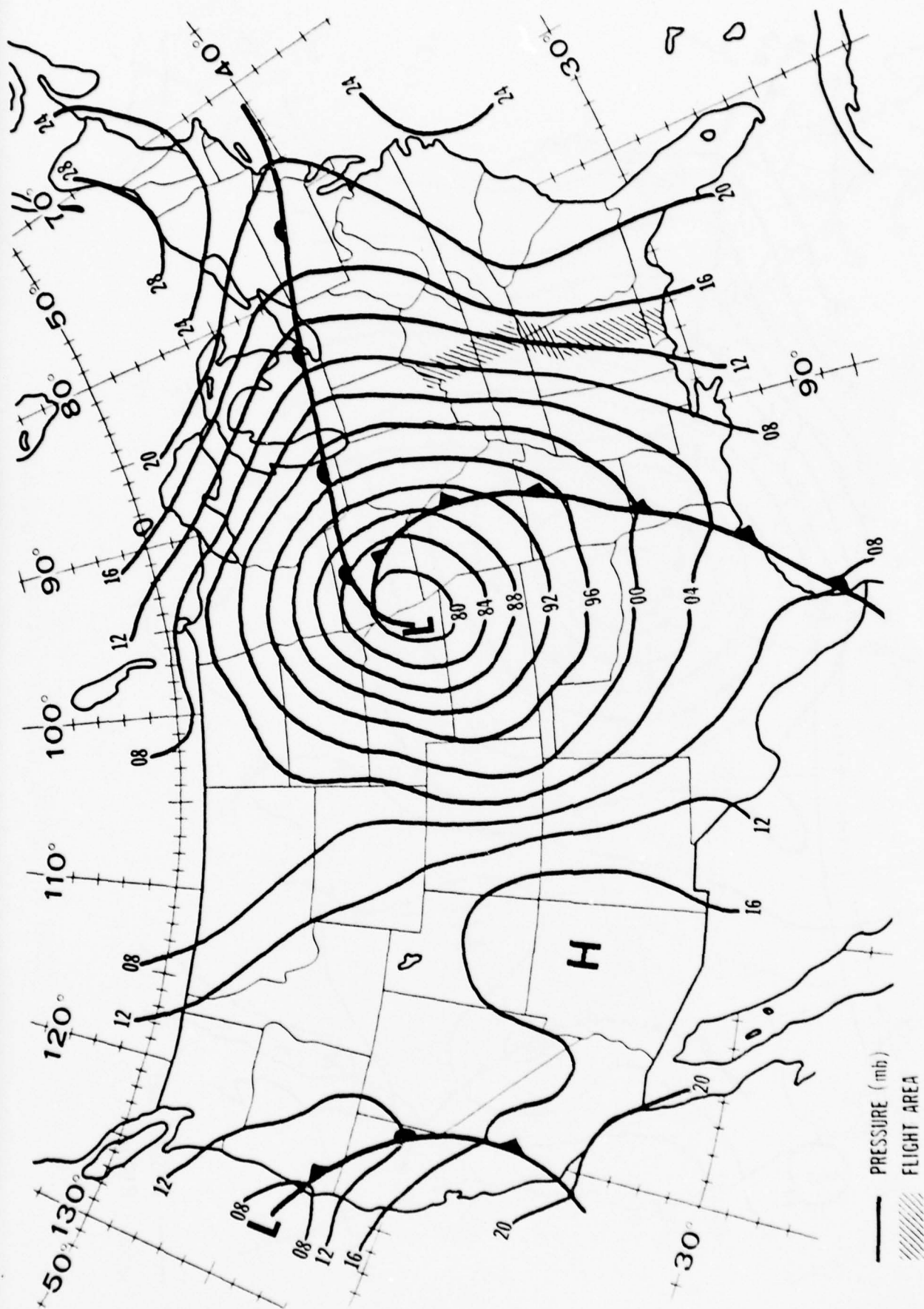


FIGURE 2. SURFACE PRESSURE - 23 FEB 77 18Z ANALYSIS

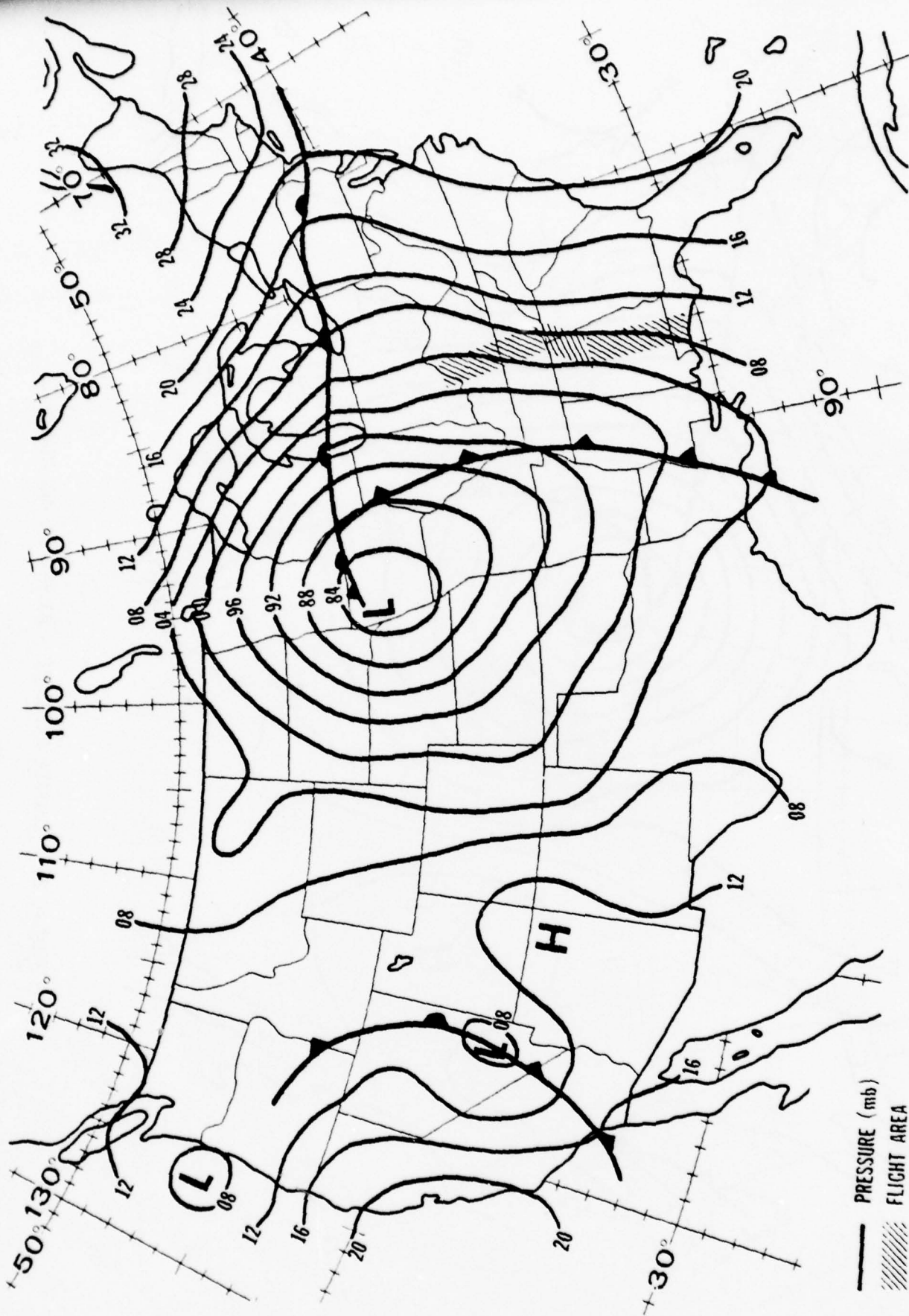


FIGURE 3. SURFACE PRESSURE - 24 FEB 77 00Z ANALYSIS

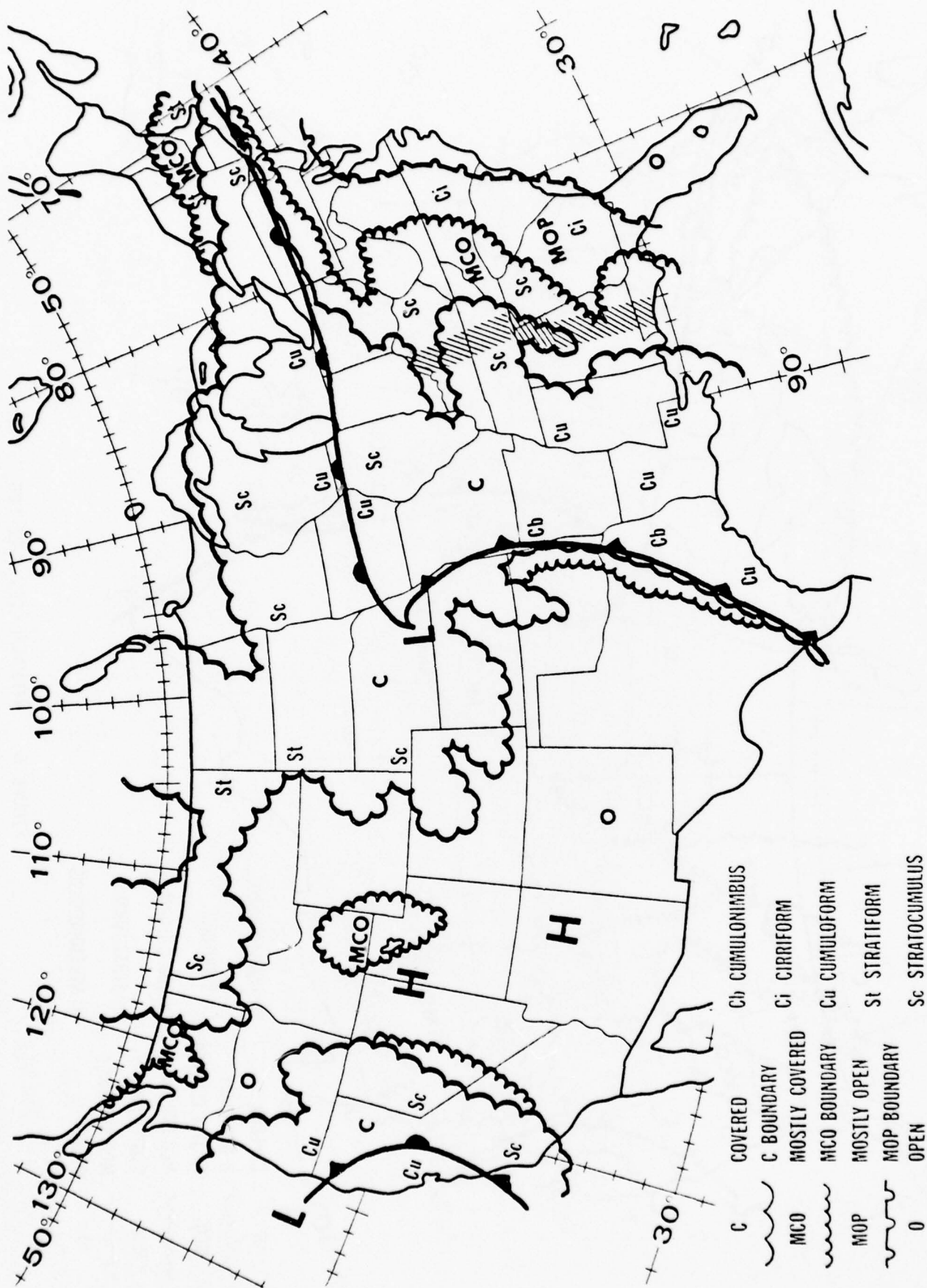


FIGURE 4. NEPHANALYSIS - 23 FEB 77 12Z

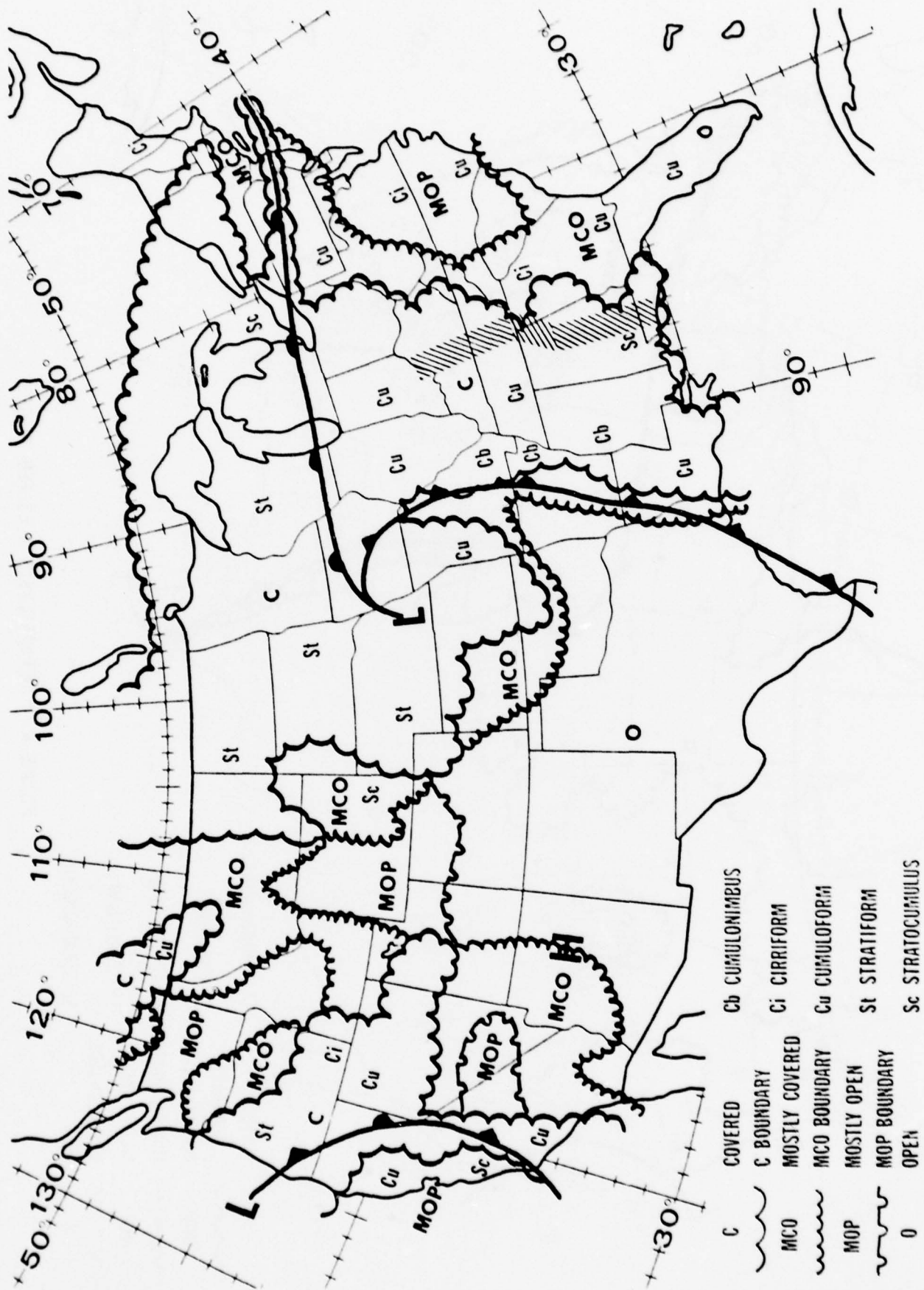


FIGURE 5. NEPAHALYSIS - 23 FEB 77 18Z

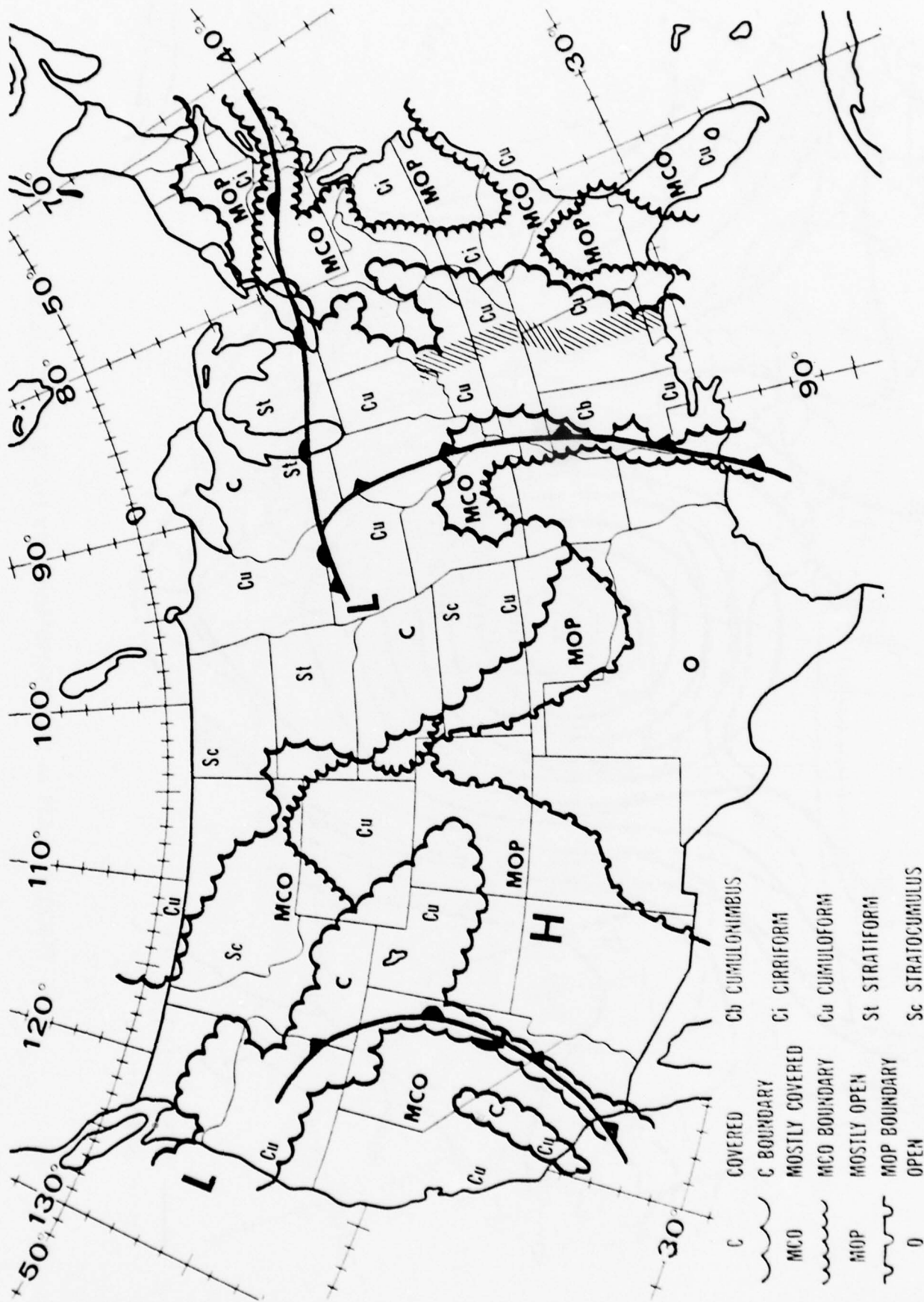


FIGURE 6. NEPHANALYSIS - 24 FEB 77 00Z

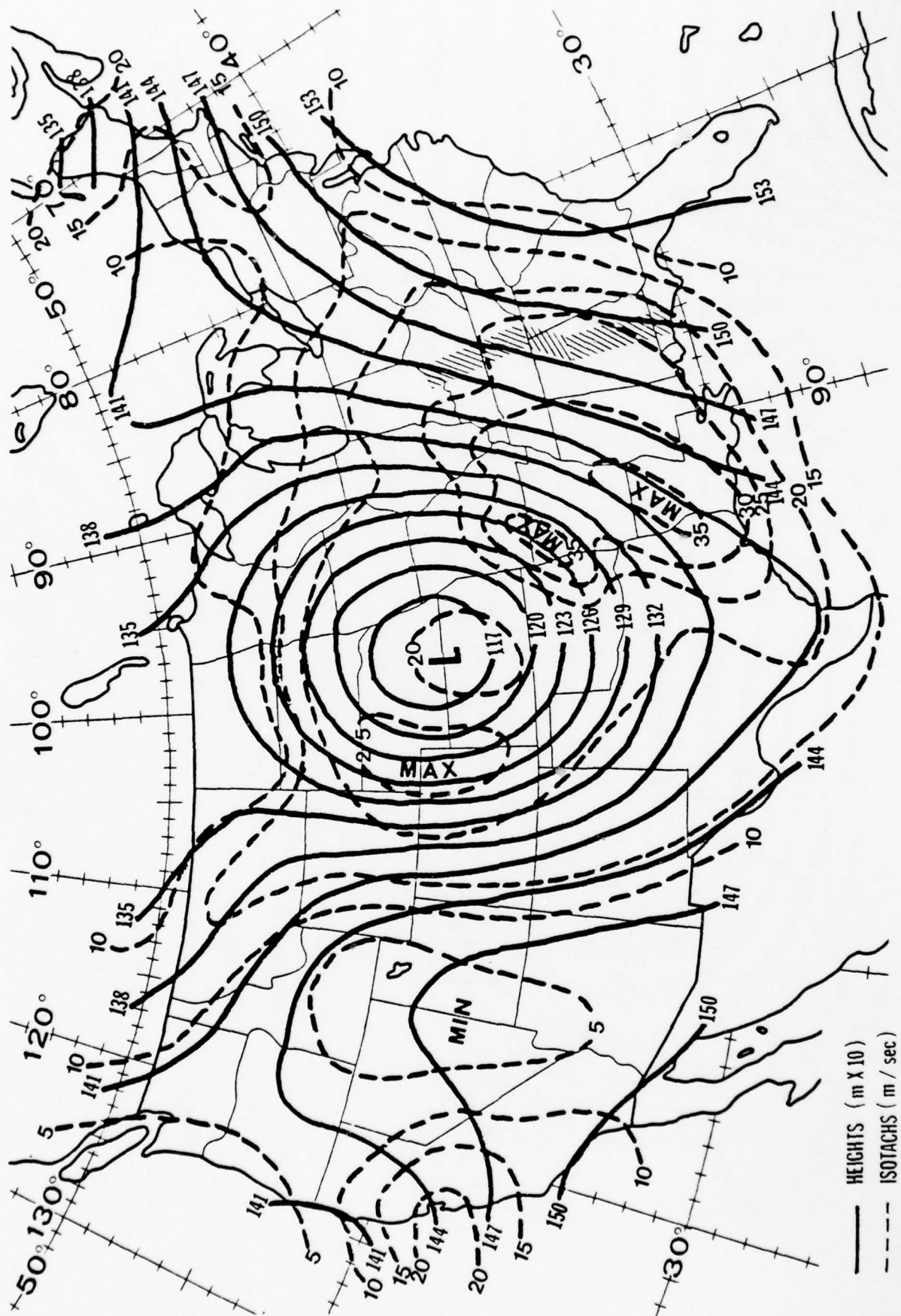


FIGURE 7. 850 mb HEIGHTS/ISOTACHS - 23 FEB 77 12Z ANALYSIS

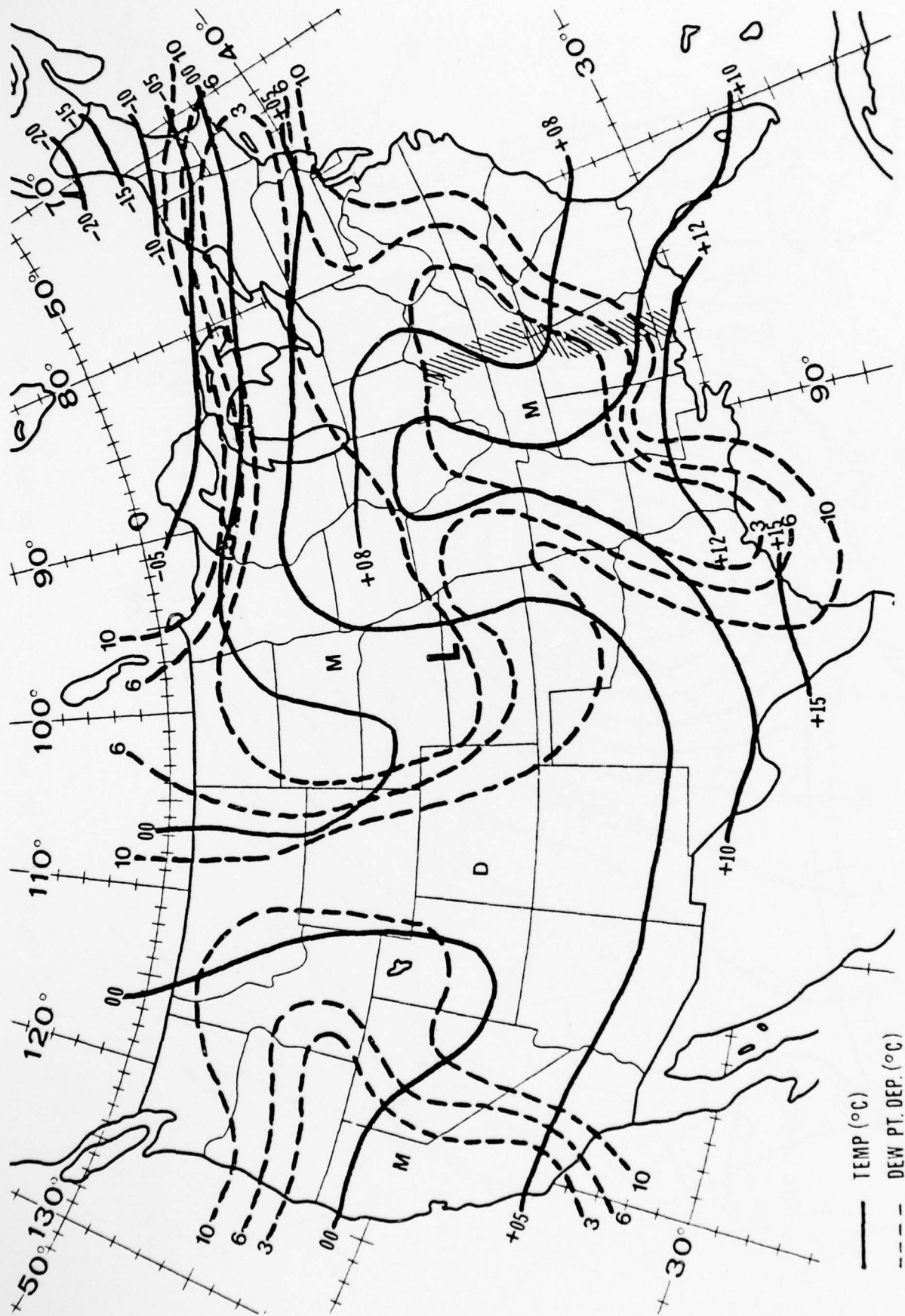


FIGURE 8. 850 mb TEMP./DEW PT. DEPRESSION - 23 FEB 77 12Z ANALYSIS

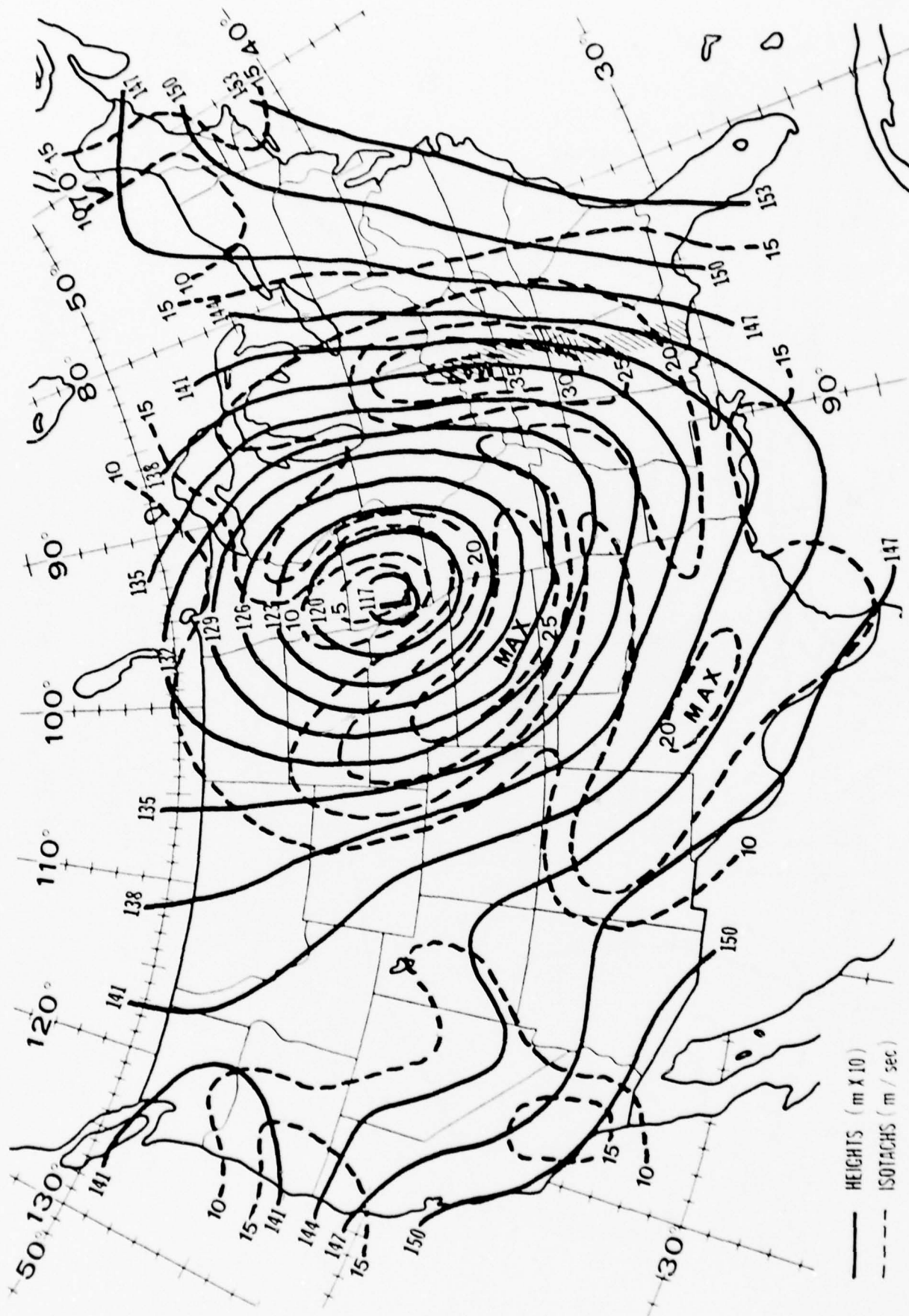


FIGURE 9. 850 mb HEIGHTS/ISOTACHS - 24 FEB 77 00Z ANALYSIS

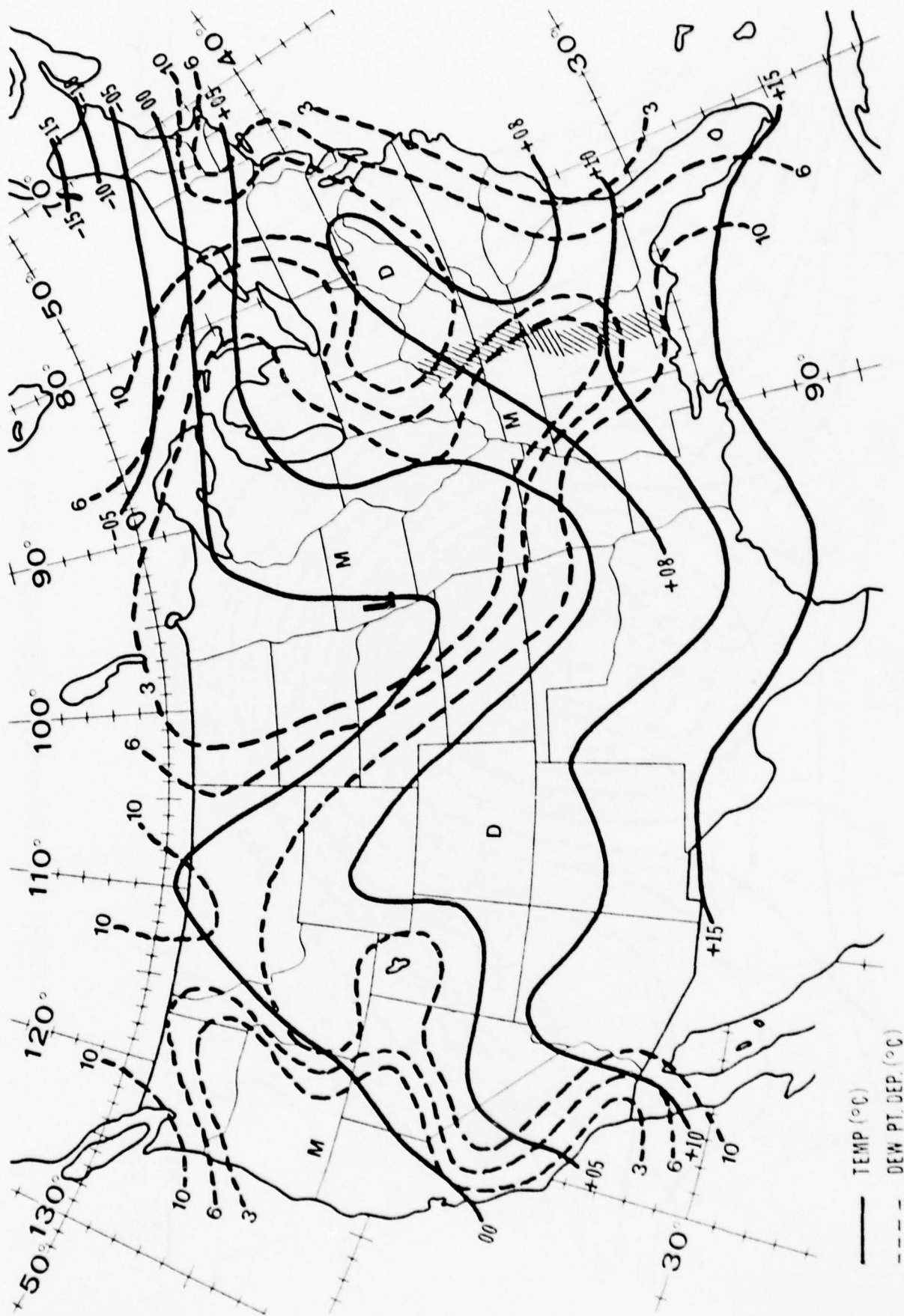


FIGURE 10. 850 mb TEMP./DEW PT. DEPRESSION - 24 FEB 77 00Z ANALYSIS

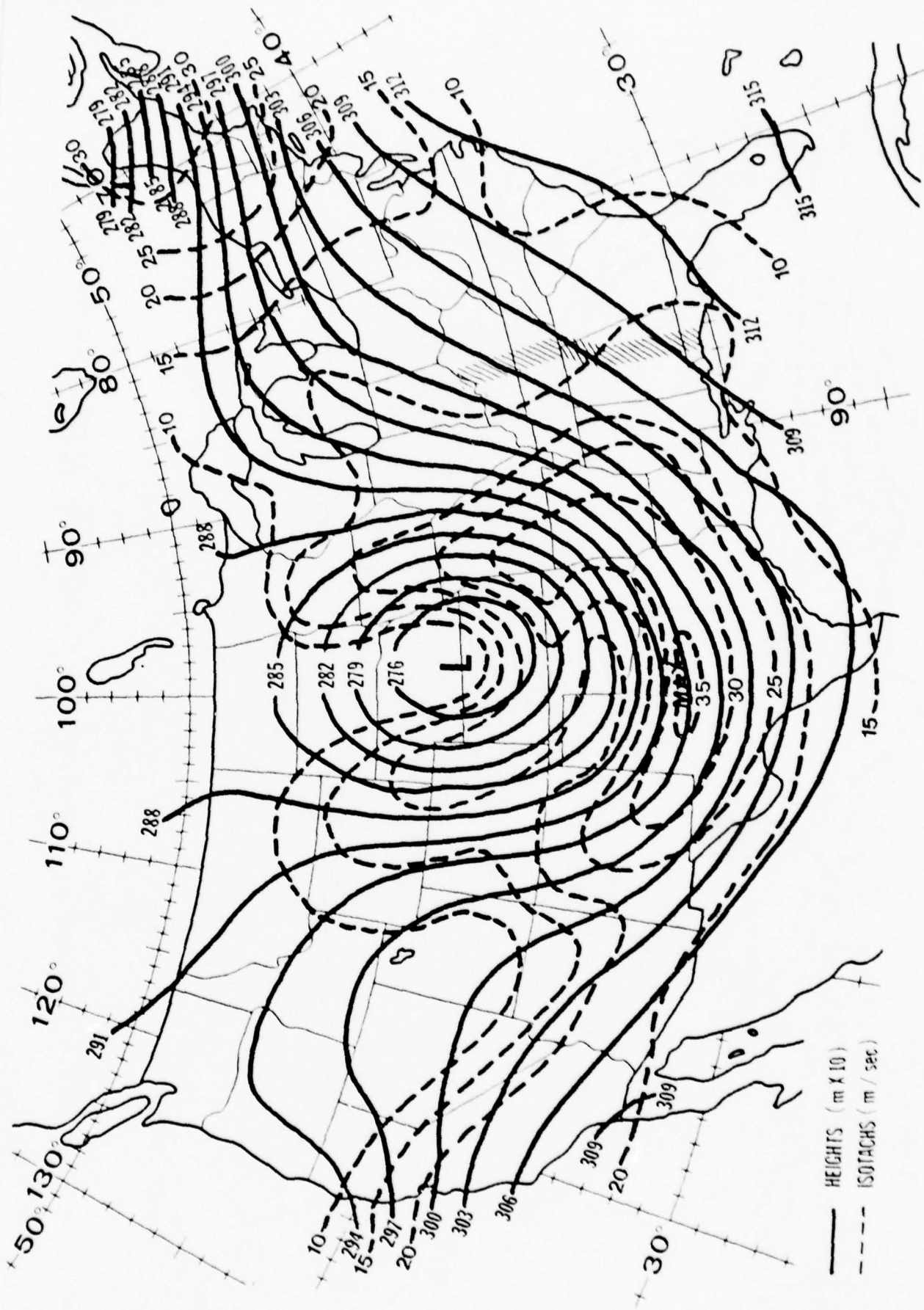


FIGURE 11. 700 mb HEIGHTS/ISOTACHS - 23 FEB 77 12Z ANALYSIS

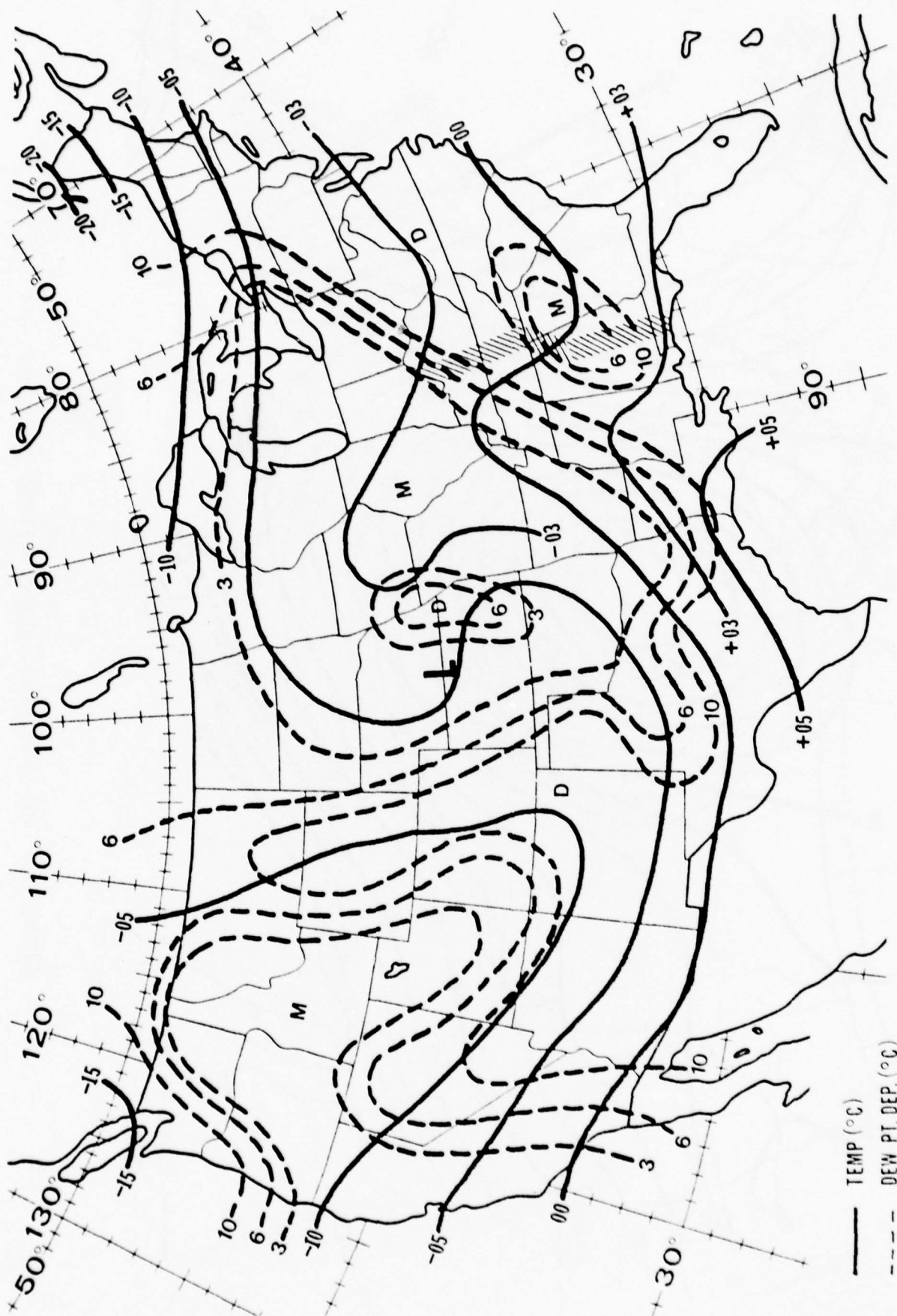


FIGURE 12. 700 mb TEMP./DEW PT. DEPRESSION - 23 FEB 77 12Z ANALYSIS

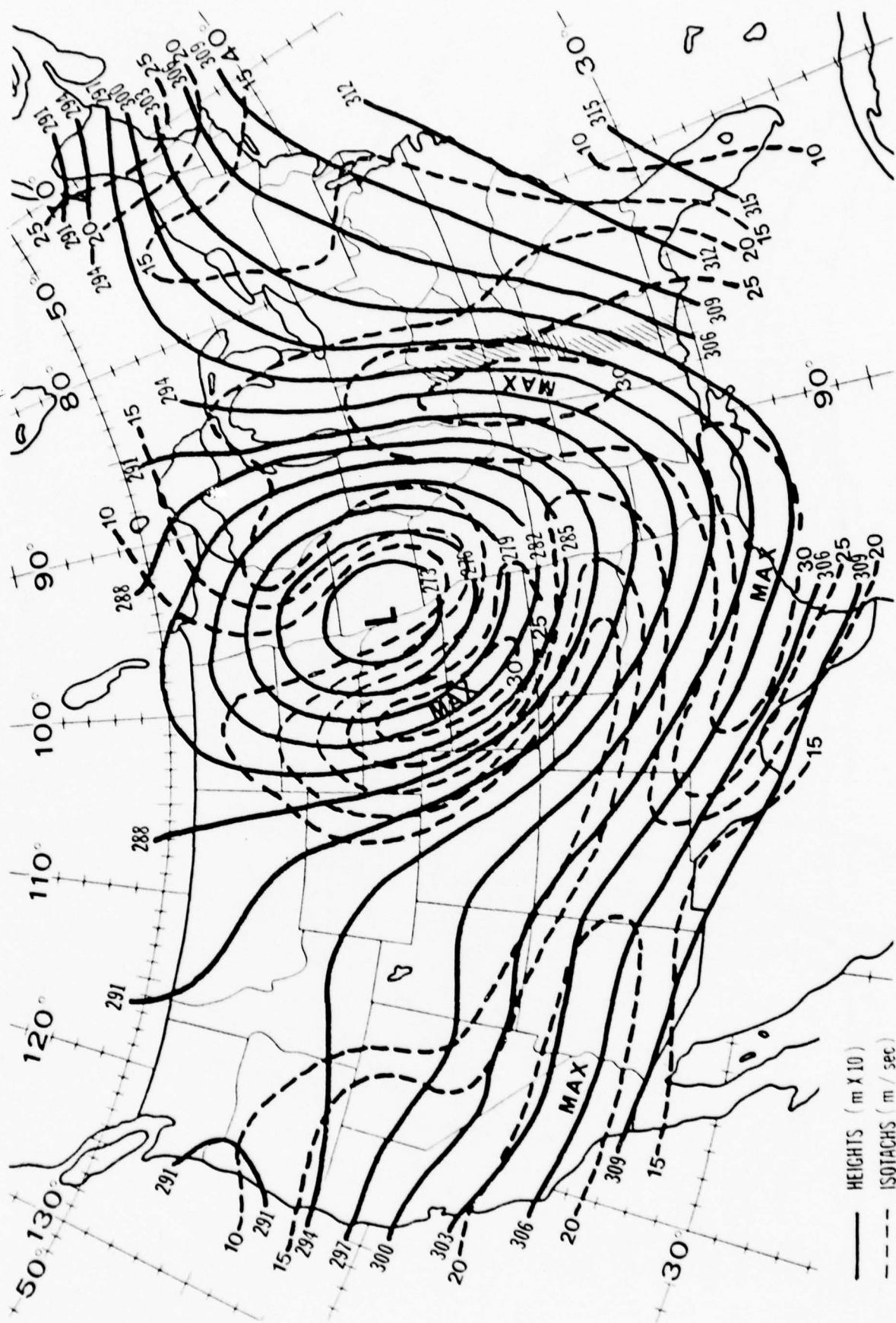


FIGURE 13. 700 mb HEIGHTS/ISOTACHS - 24 FEB 77 00Z ANALYSIS

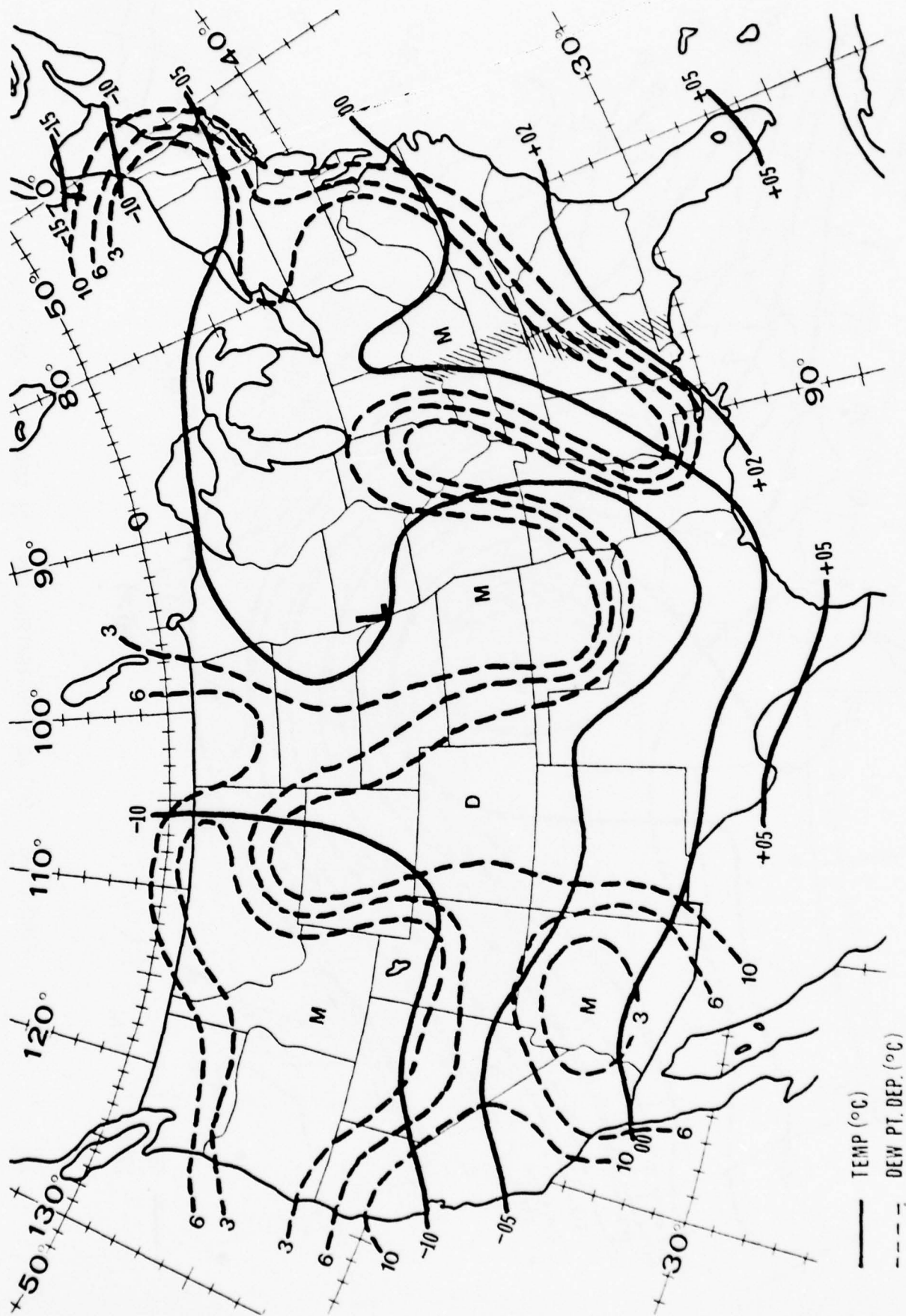


FIGURE 14. 700 mb TEMP./DEW PT. DEPRESSION - 24 FEB 77 00Z ANALYSIS

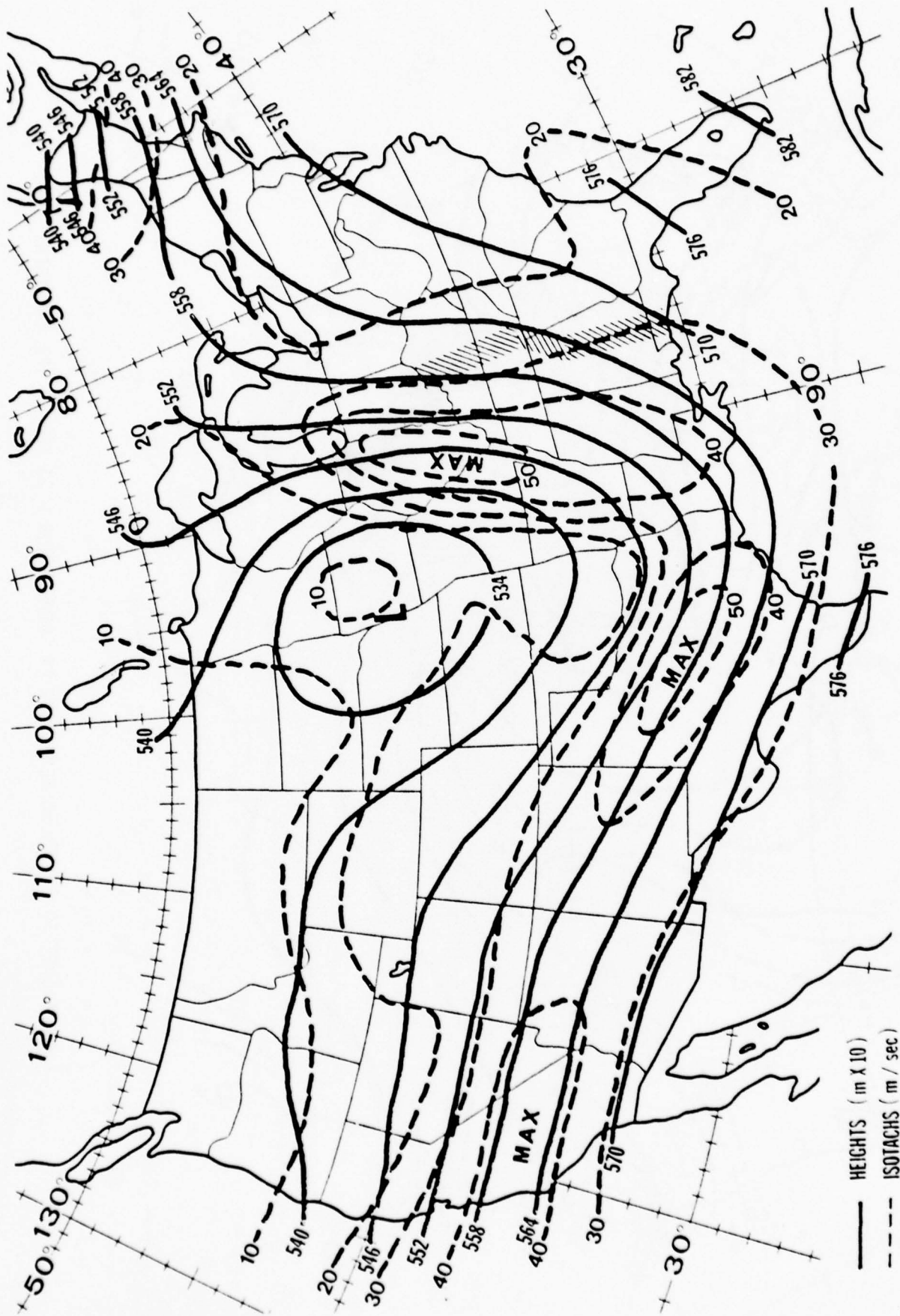


FIGURE 17. 500 mb HEIGHTS/ISOTACHS - 24 FEB 77 00Z ANALYSIS

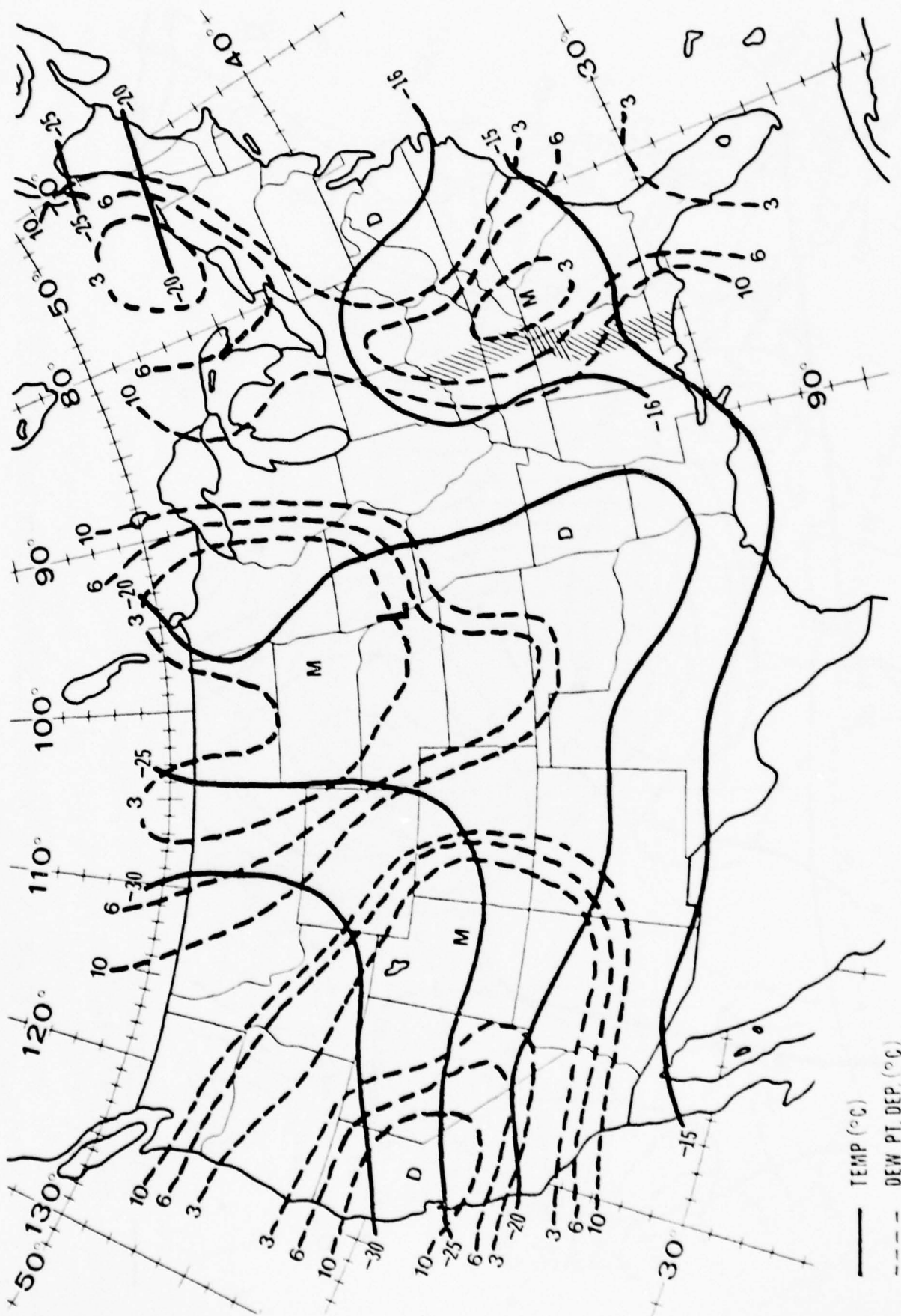


FIGURE 18. 500 mb TEMP./DEW PT. DEPRESSION - 24 FEB 77 00Z ANALYSIS

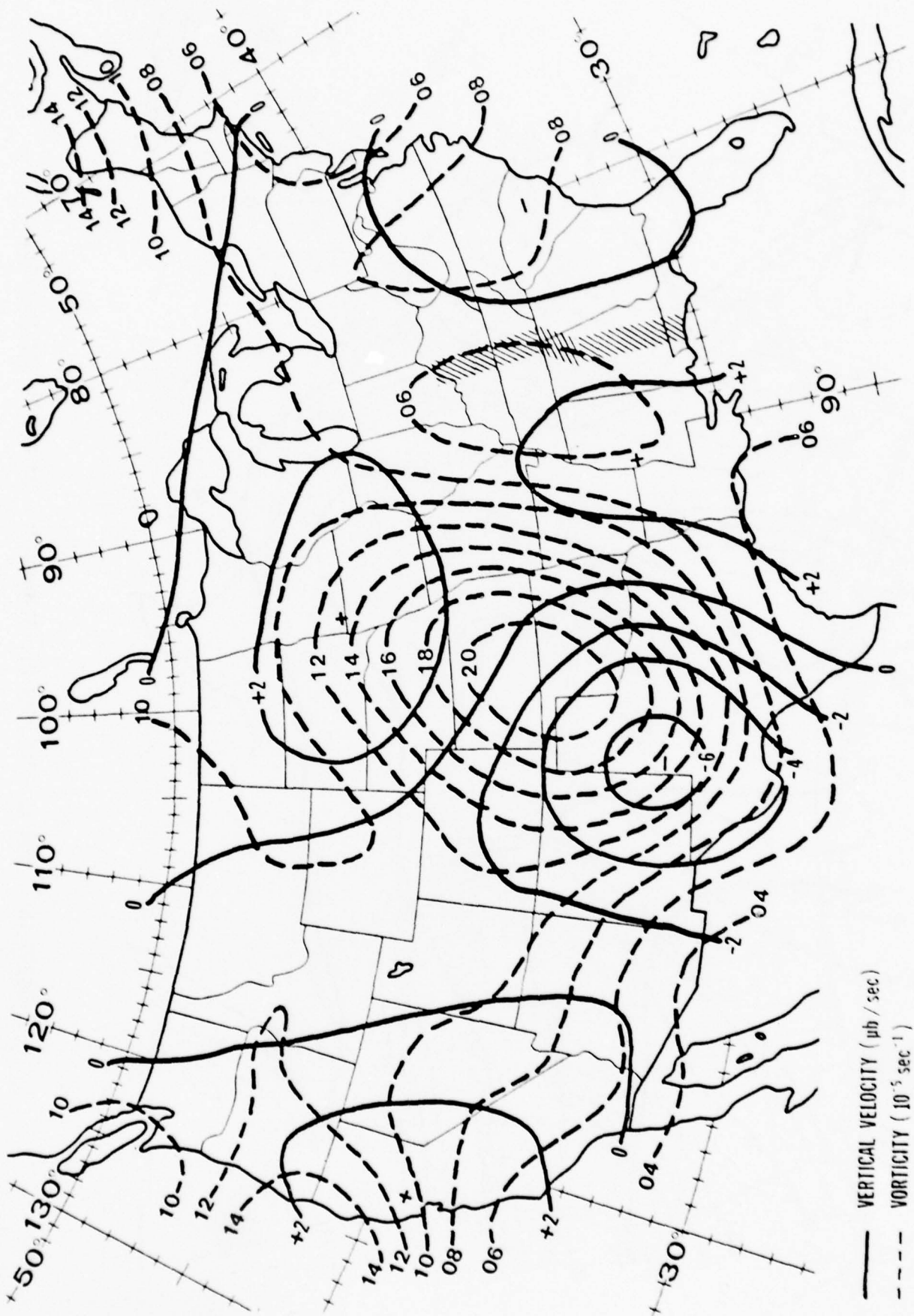


FIGURE 19. 500 mb VERT. VELOCITY/VORTICITY - 23 FEB 77 12Z ANALYSIS

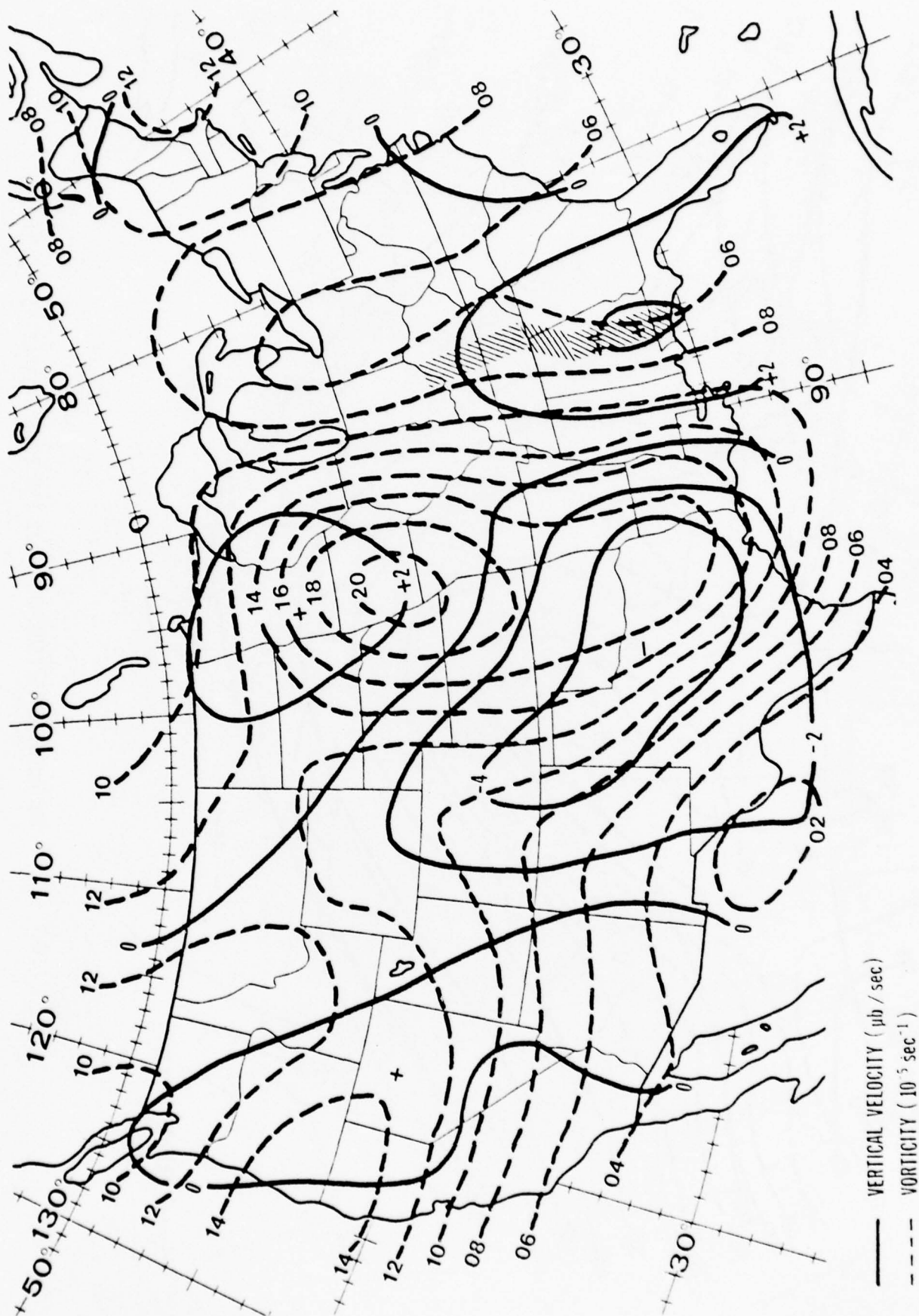


FIGURE 20. 500 mb VERT. VELOCITY/VORTICITY - 24 FEB 77 00Z ANALYSIS

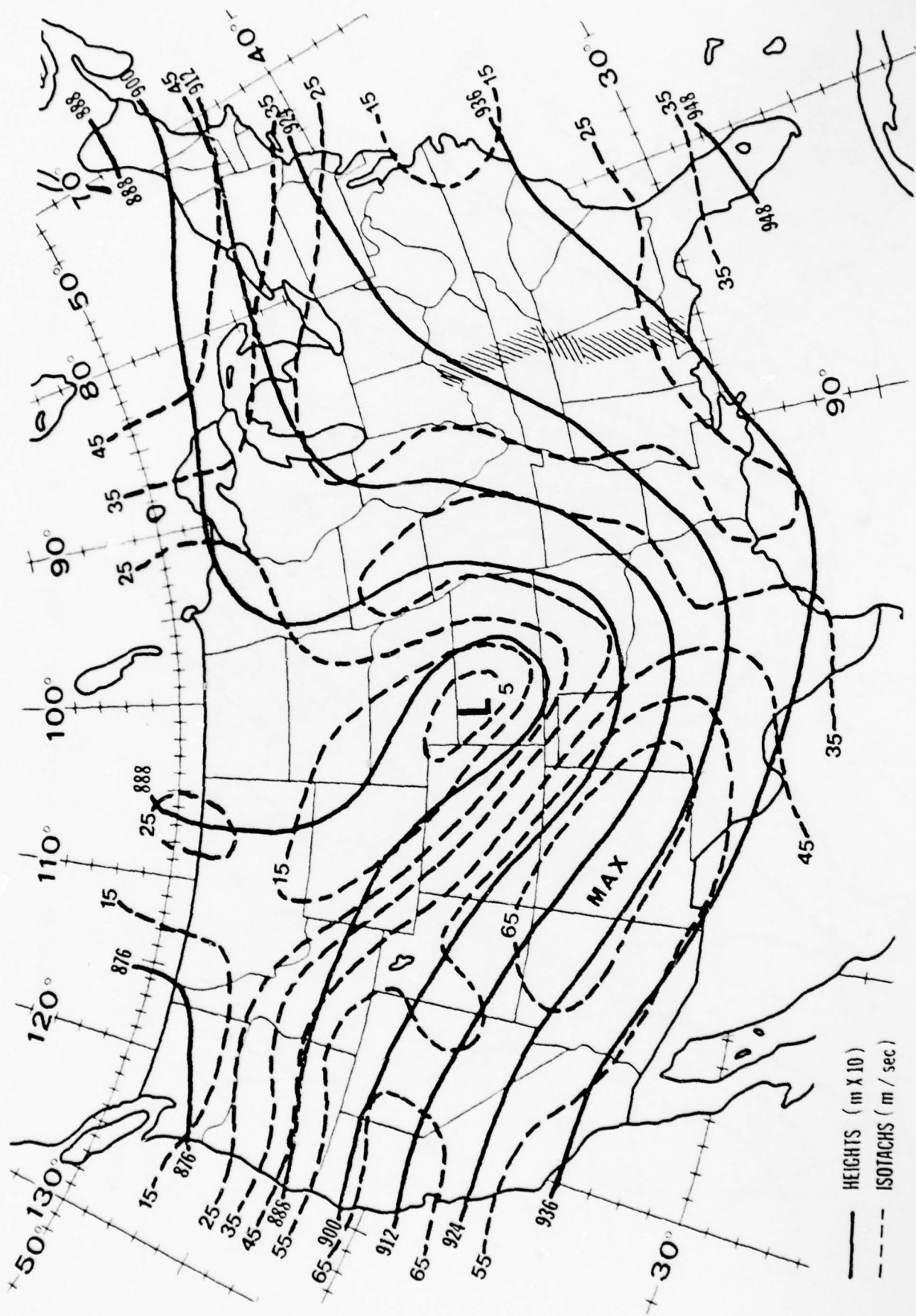


FIGURE 21. 300 mb HEIGHTS/ISOTACHS - 23 FEB 77 12Z ANALYSIS

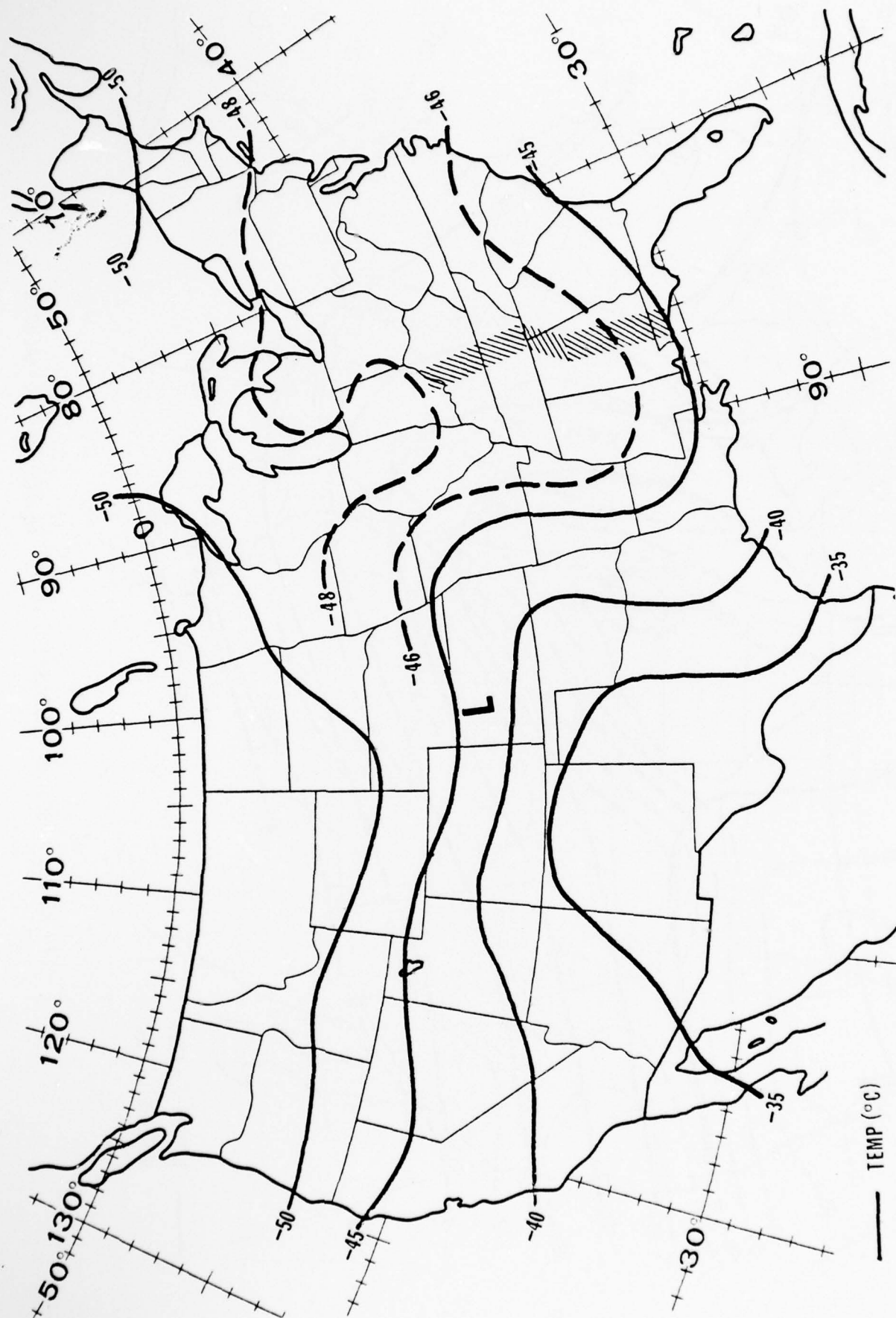


FIGURE 22. 300 mb TEMPERATURE - 23 FEB 77 12Z ANALYSIS

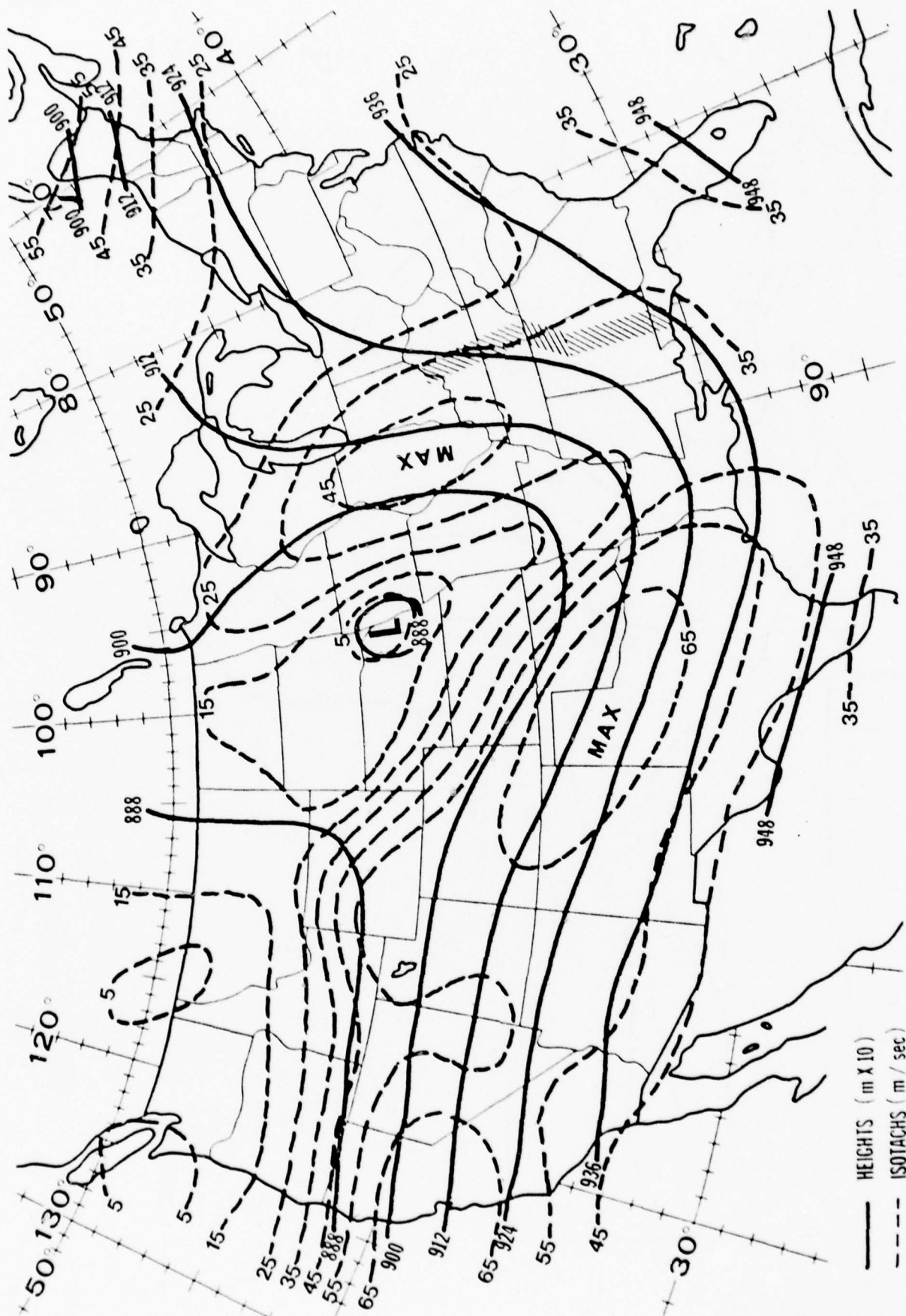


FIGURE 23. 300 mb HEIGHTS/ISOTACHS - 24 FEB 77 00Z ANALYSIS

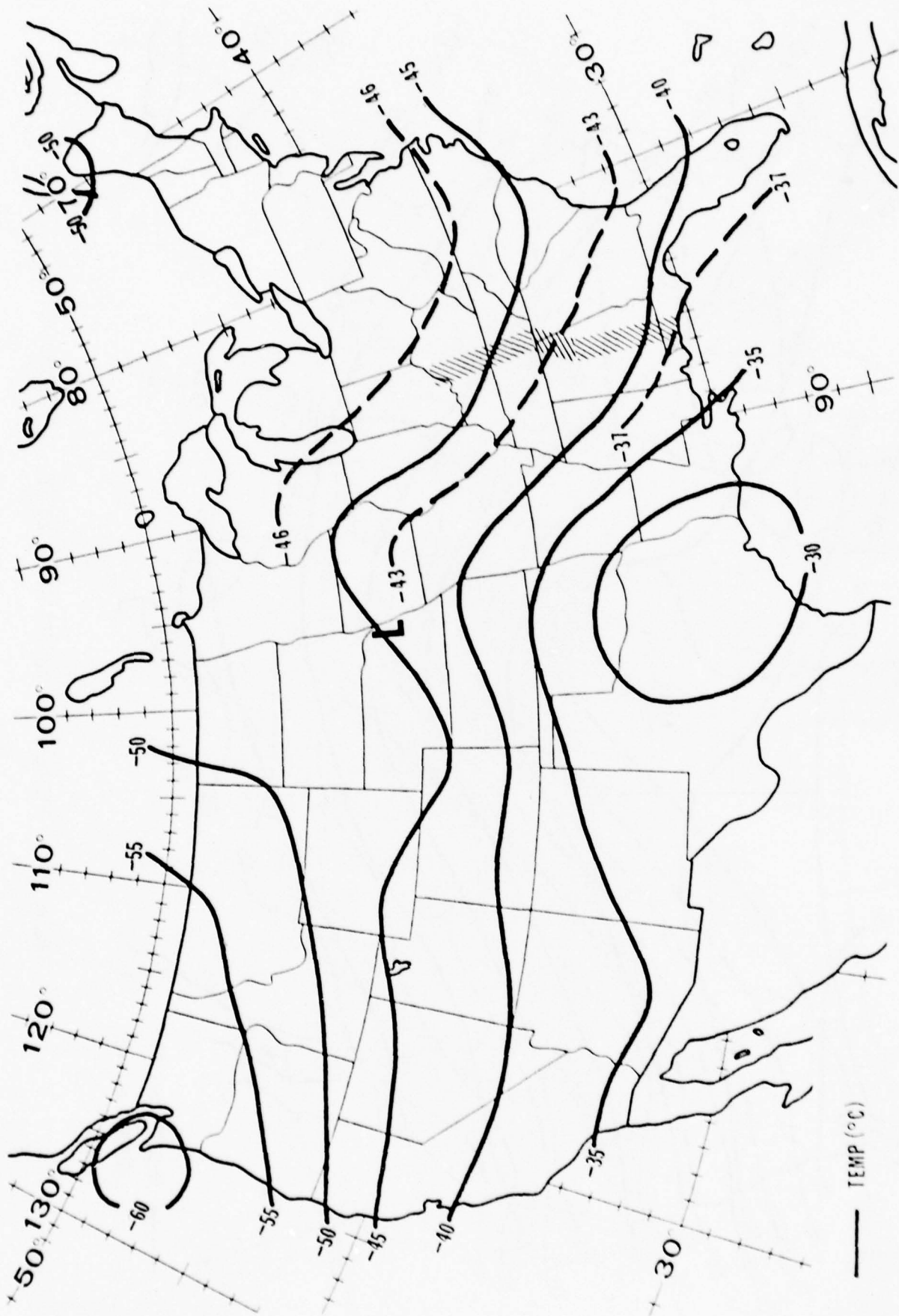


FIGURE 24. 300 mb TEMPERATURE - 24 FEB 77 00Z ANALYSIS

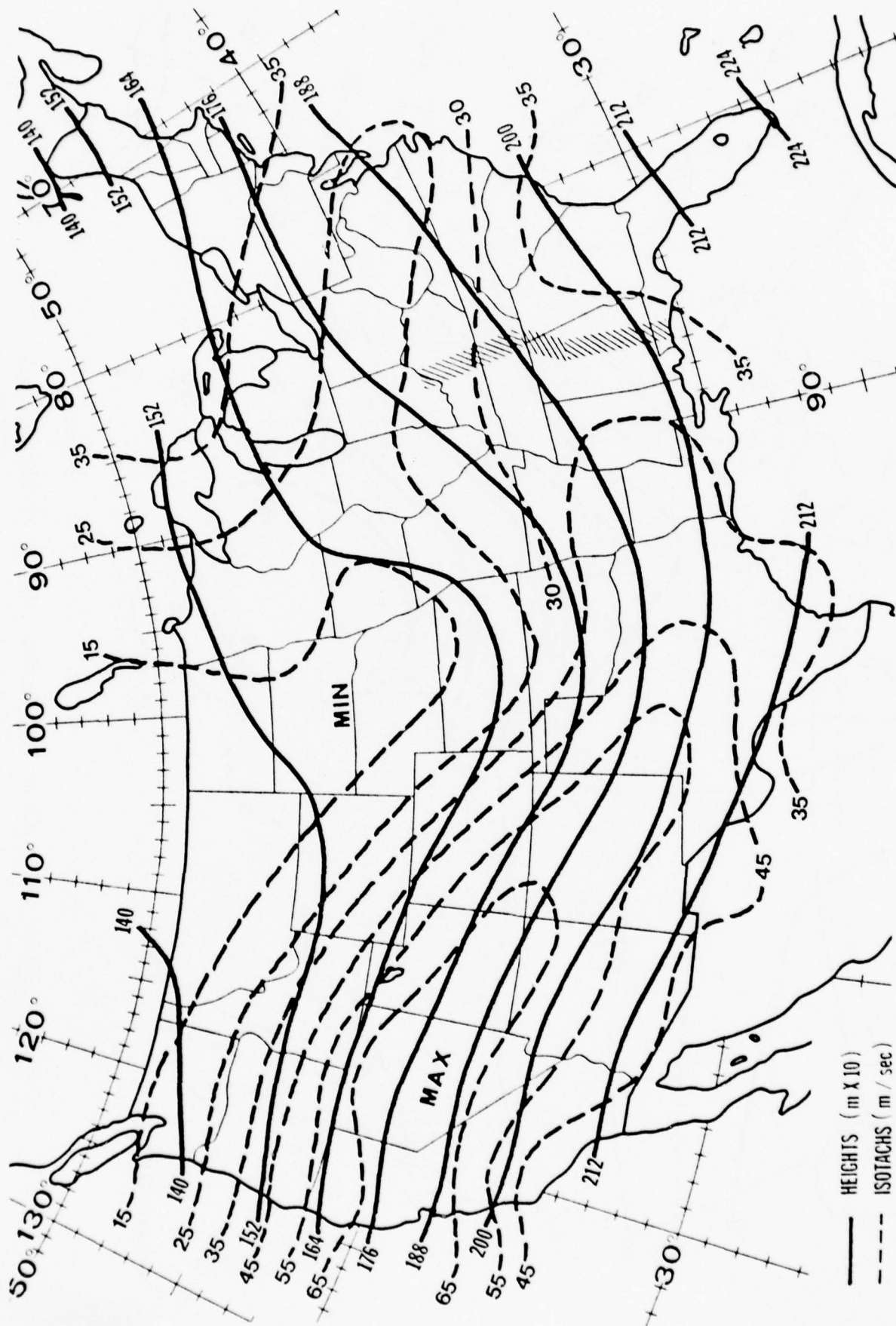


FIGURE 25. 200 mb HEIGHTS/ISOTACHS - 23 FEB 77 12Z ANALYSIS

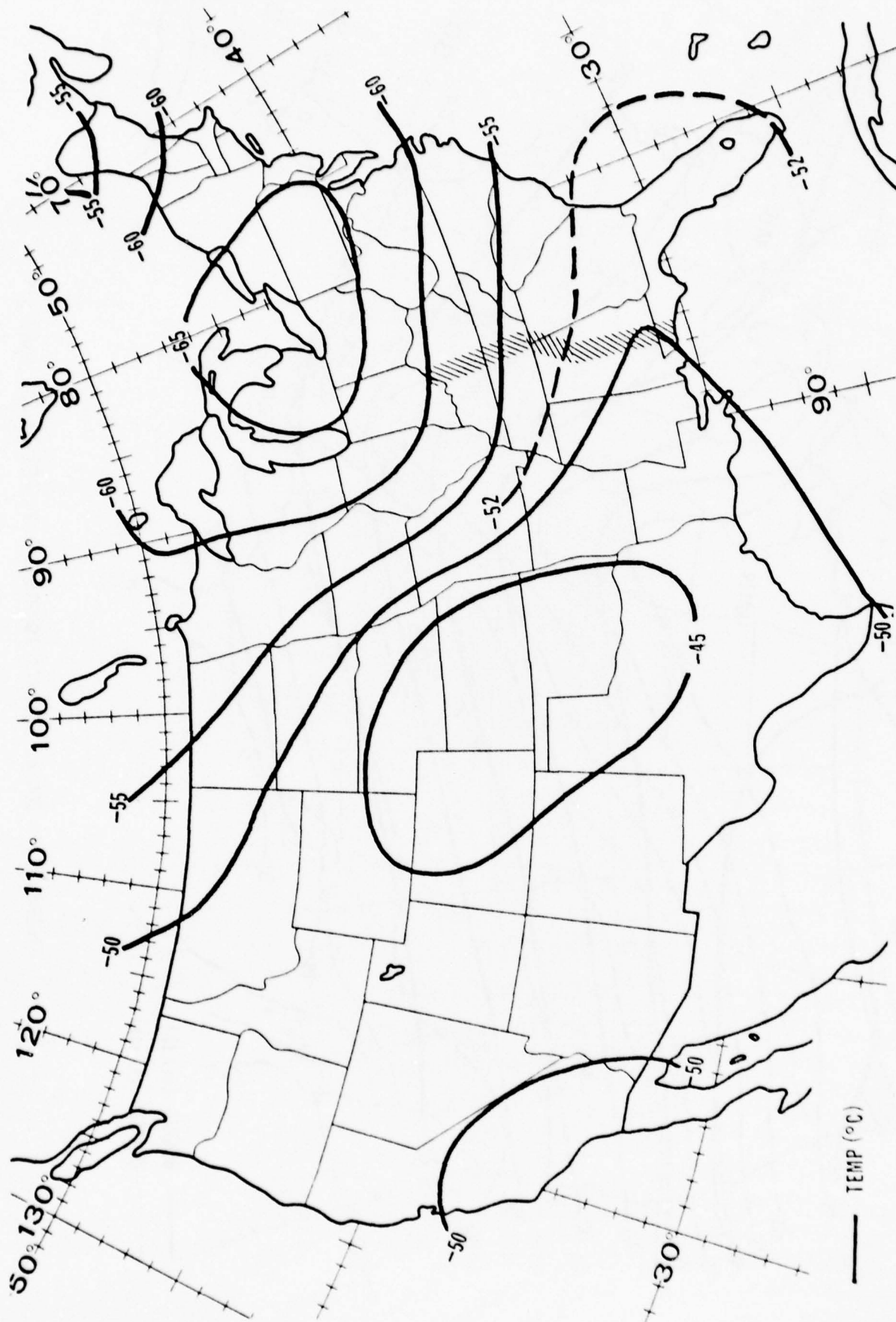


FIGURE 26. 200 mb TEMPERATURE - 23 FEB 77 12Z ANALYSIS

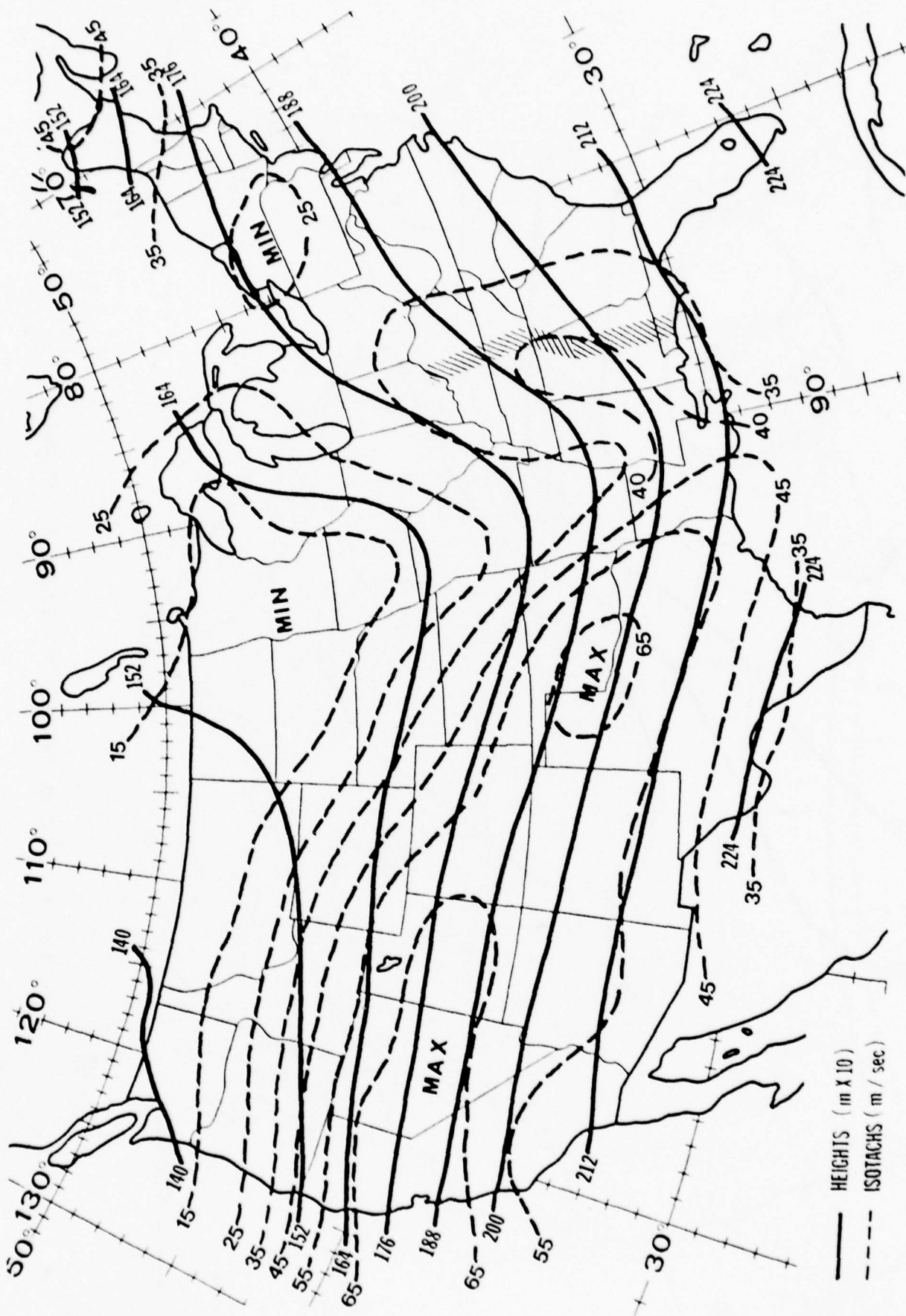


FIGURE 27. 200 mb HEIGHTS/ISOTACHS - 24 FEB 77 00Z ANALYSIS

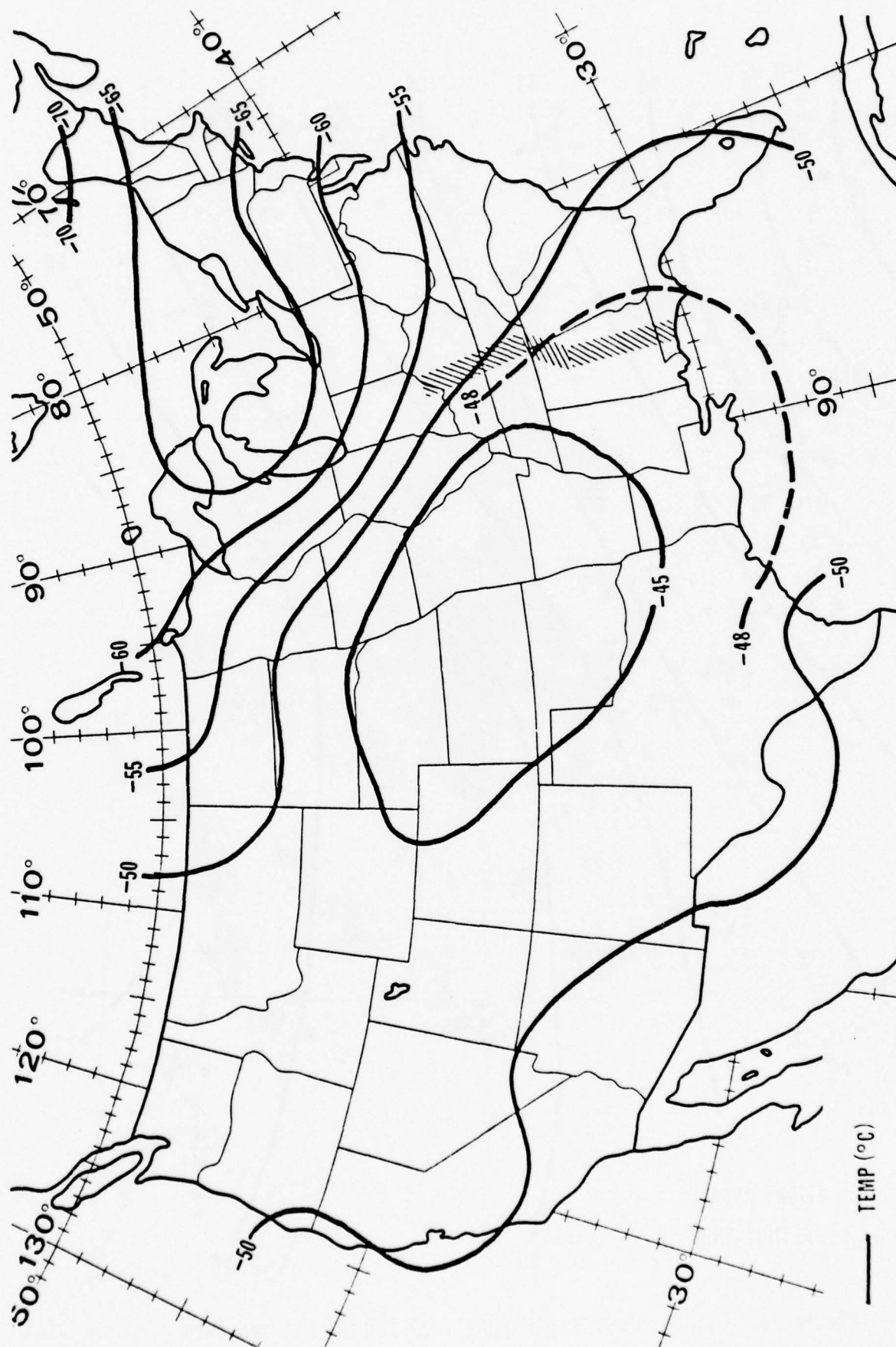


FIGURE 28. 200 mb TEMPERATURE - 24 FEB 77 00Z ANALYSIS

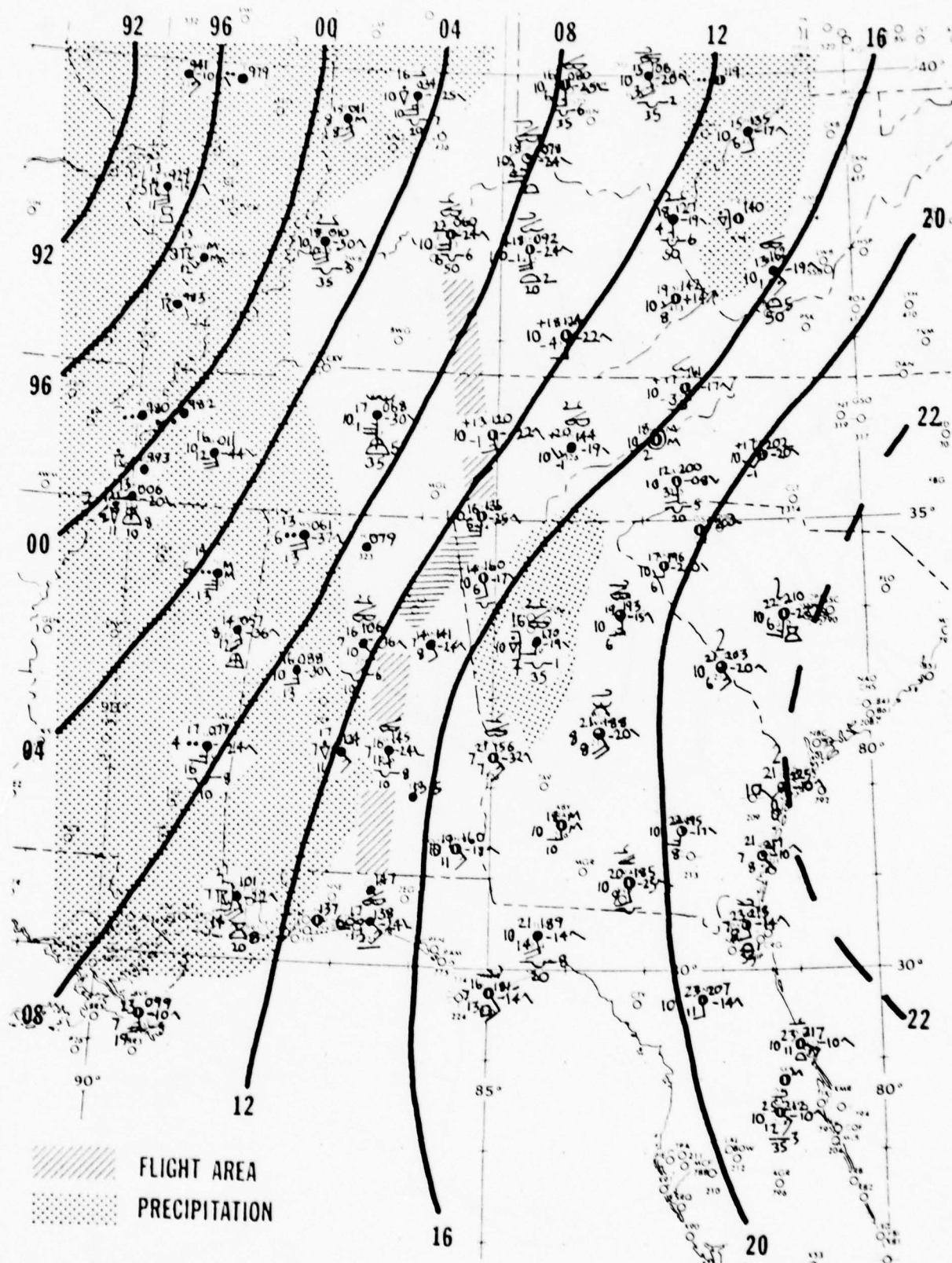


FIGURE 29. LOCAL SURFACE PRESSURE - 23 FEB 77 18Z ANALYSIS

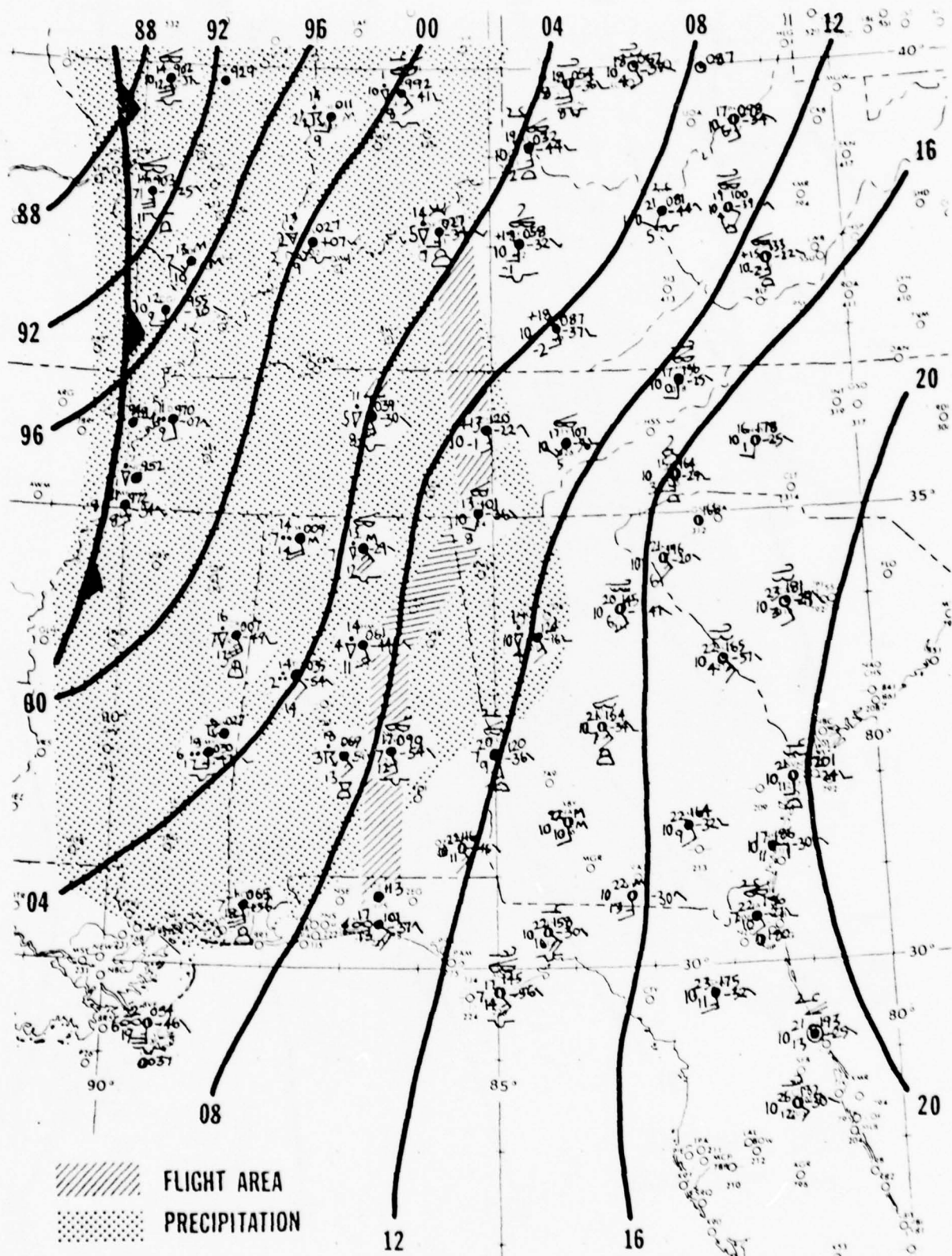


FIGURE 30. LOCAL SURFACE PRESSURE - 23 FEB 77 21Z ANALYSIS

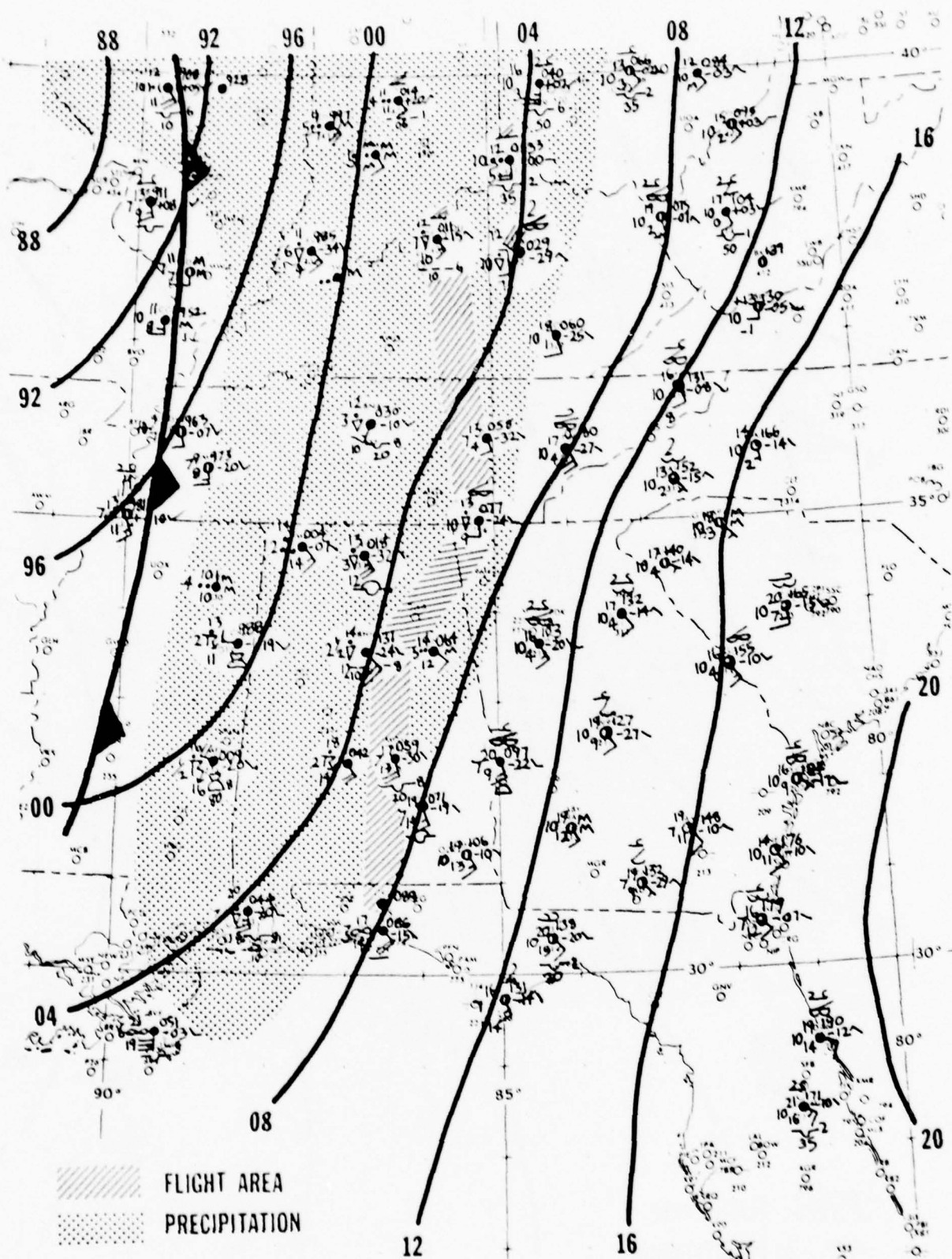


FIGURE 31. LOCAL SURFACE PRESSURE - 24 FEB 77 00Z ANALYSIS

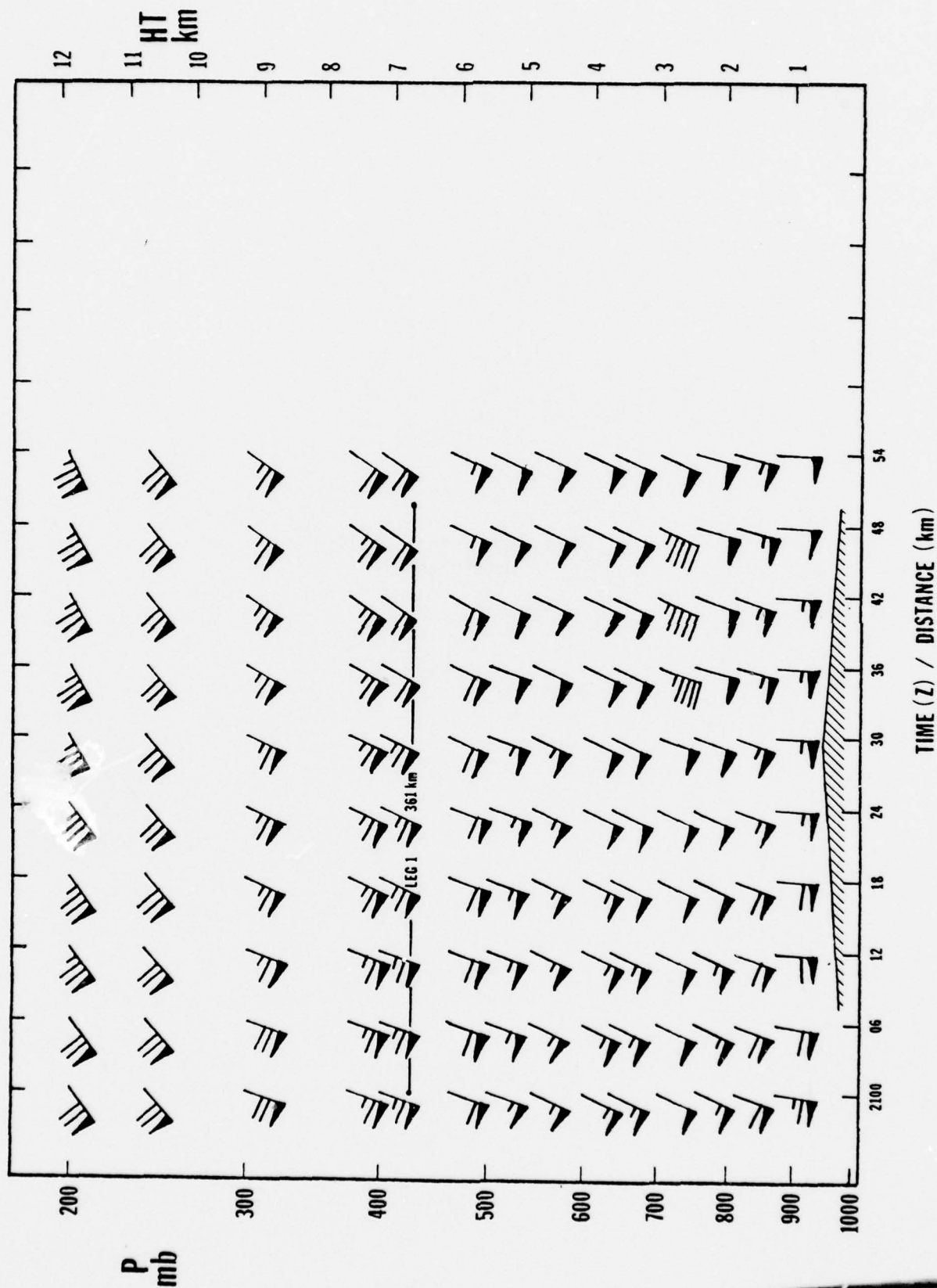


FIGURE 32. WIND CROSS-SECTION, LEG 1 - 23 FEB 77 ANALYSIS

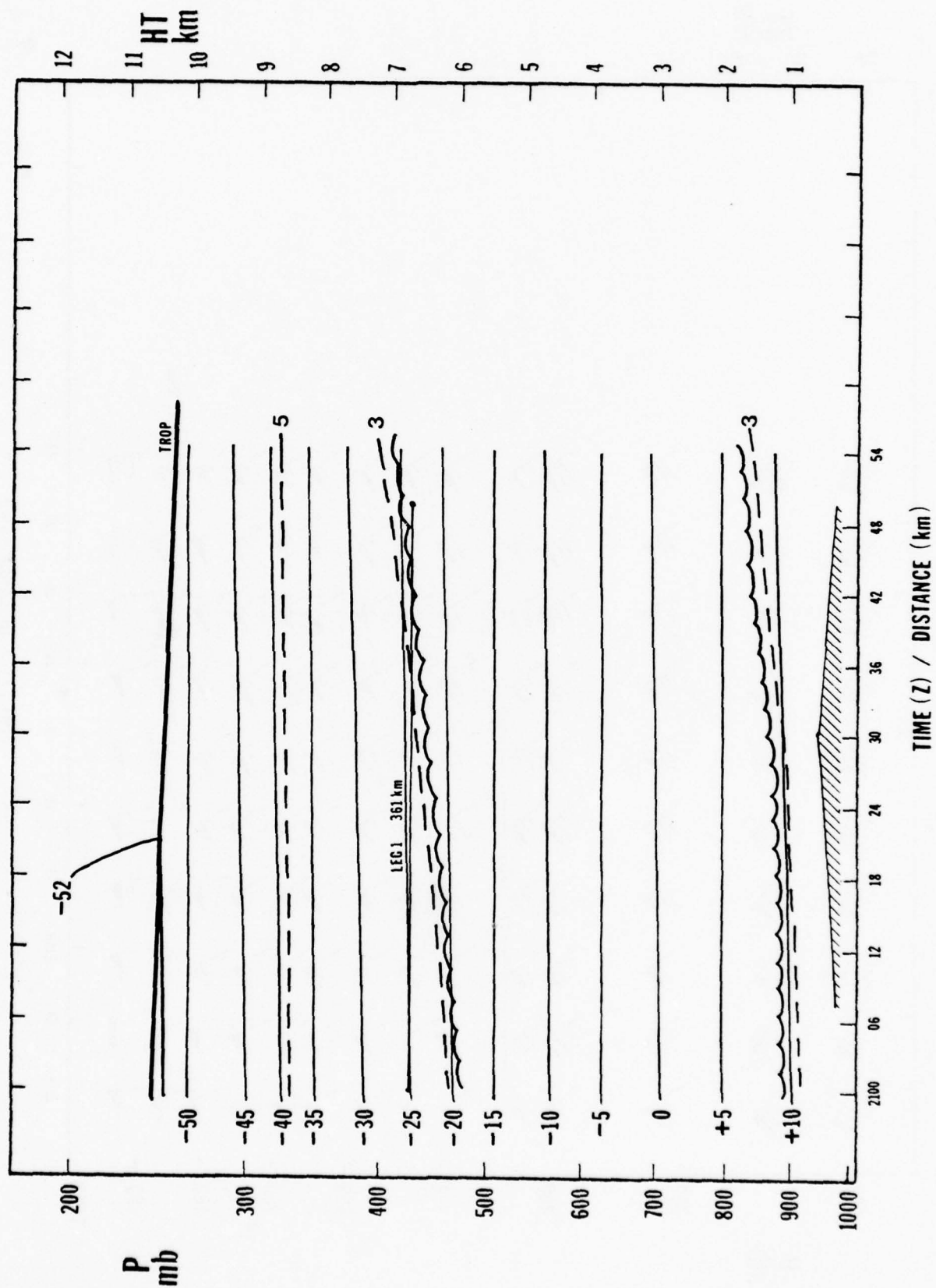


FIGURE 33. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEG 1 - 23 FEB 77 ANALYSIS

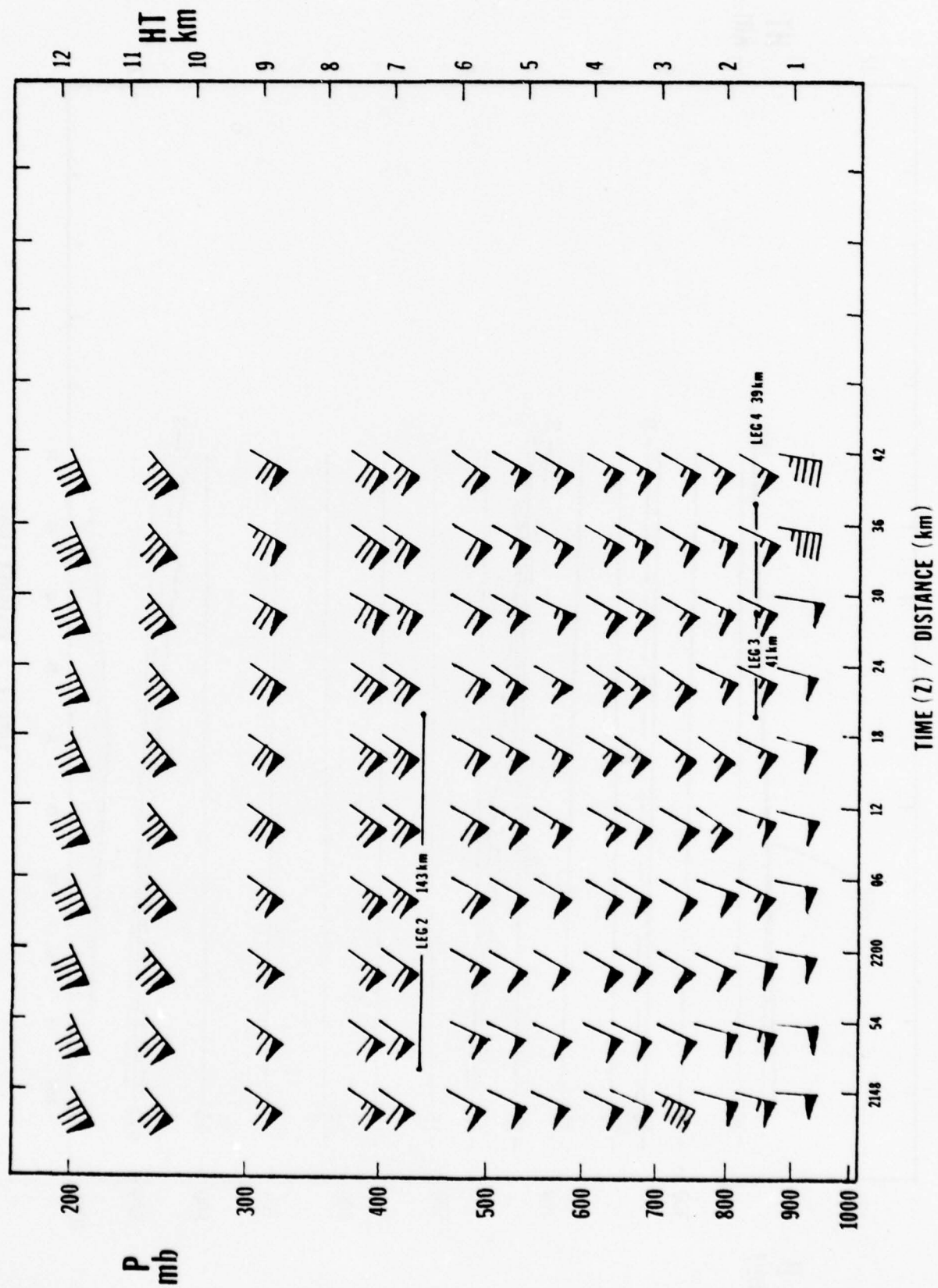


FIGURE 34. WIND CROSS-SECTION, LEGS 2, 3, AND 4 - 23 FEB 77 ANALYSIS

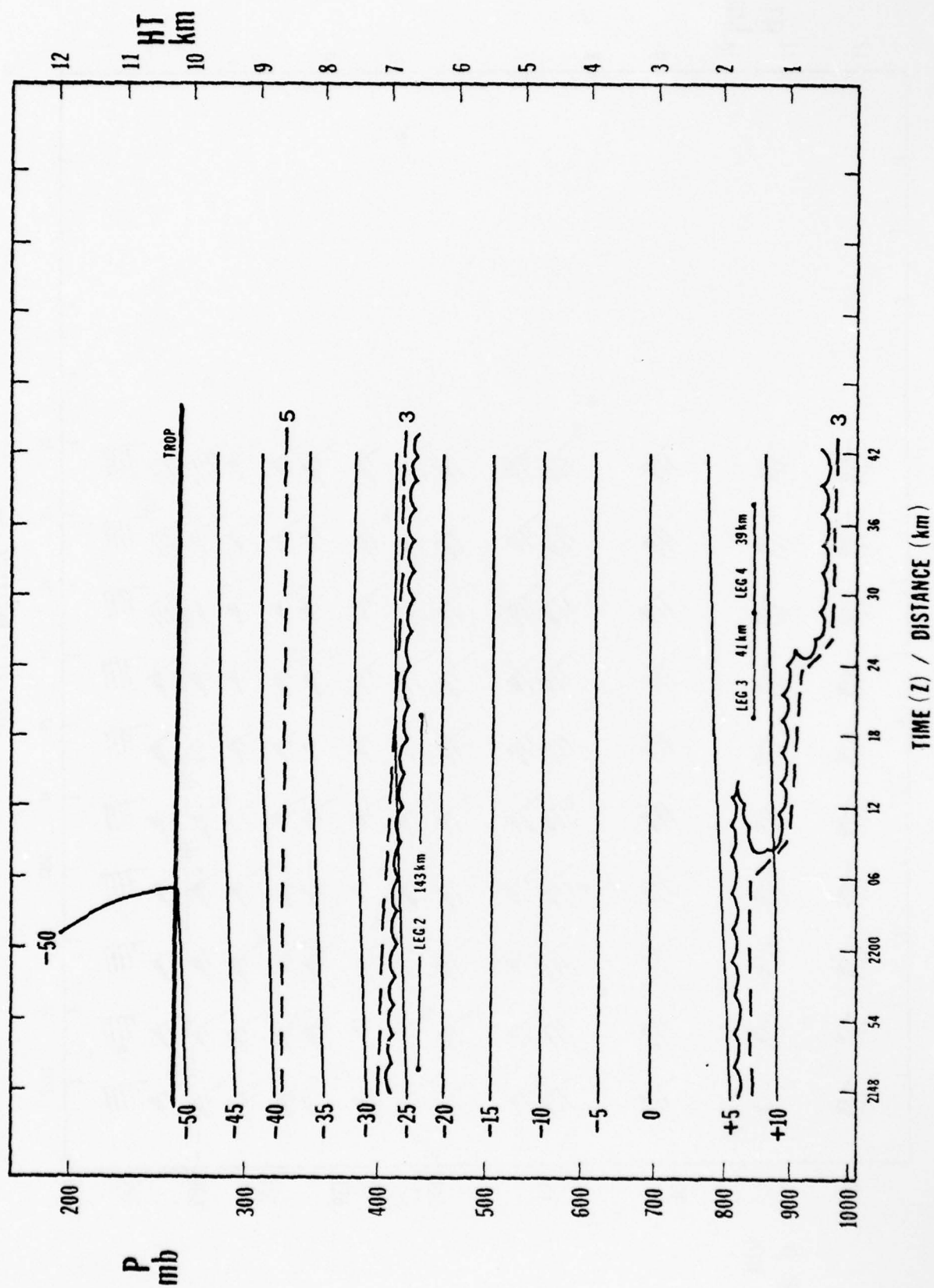


FIGURE 35. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEGS 2, 3, AND 4 - 23 FEB 77 ANALYSIS

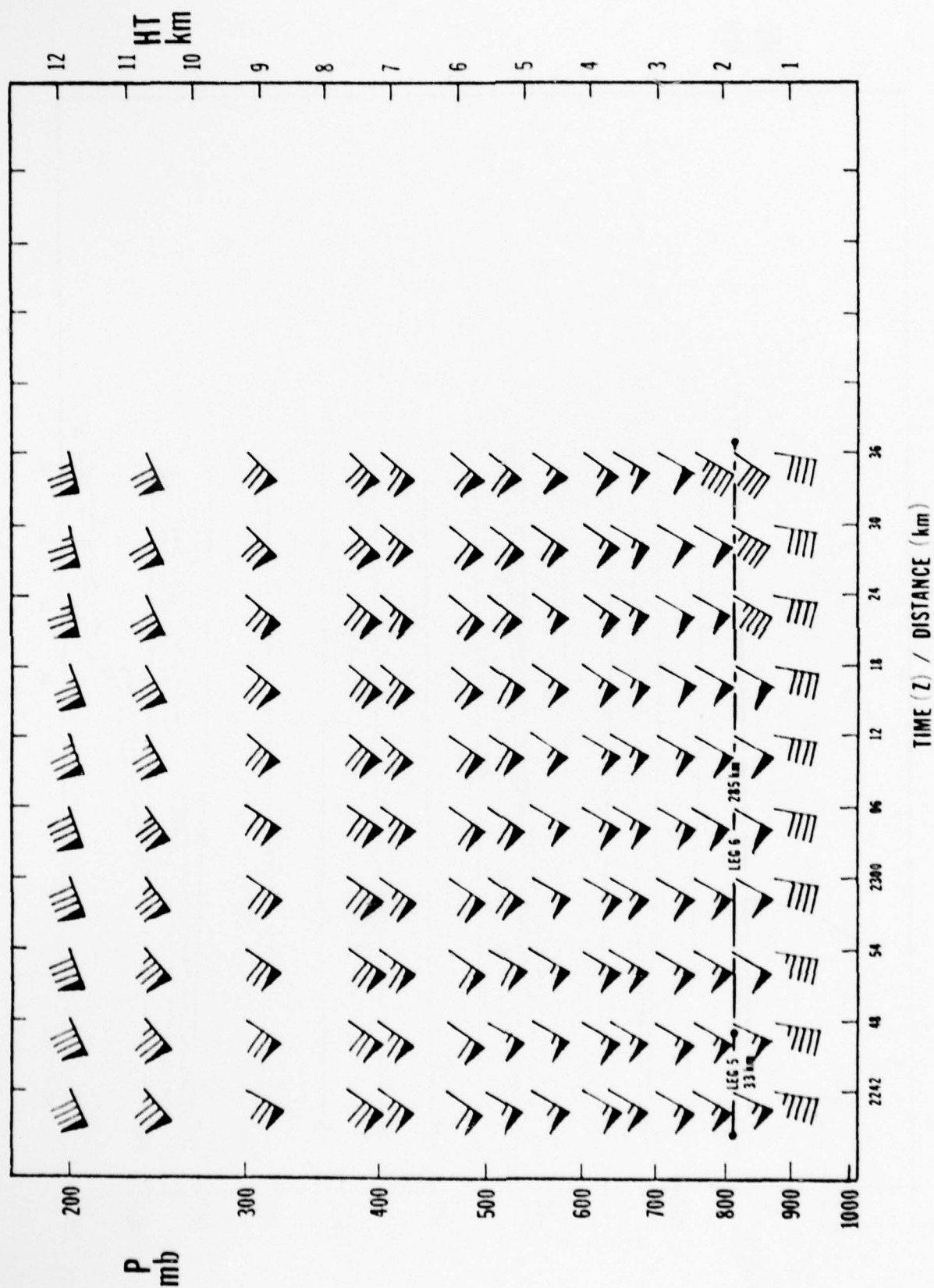


FIGURE 36. WIND CROSS-SECTION, LEGS 5 AND 6 - 23 FEB 77 ANALYSIS

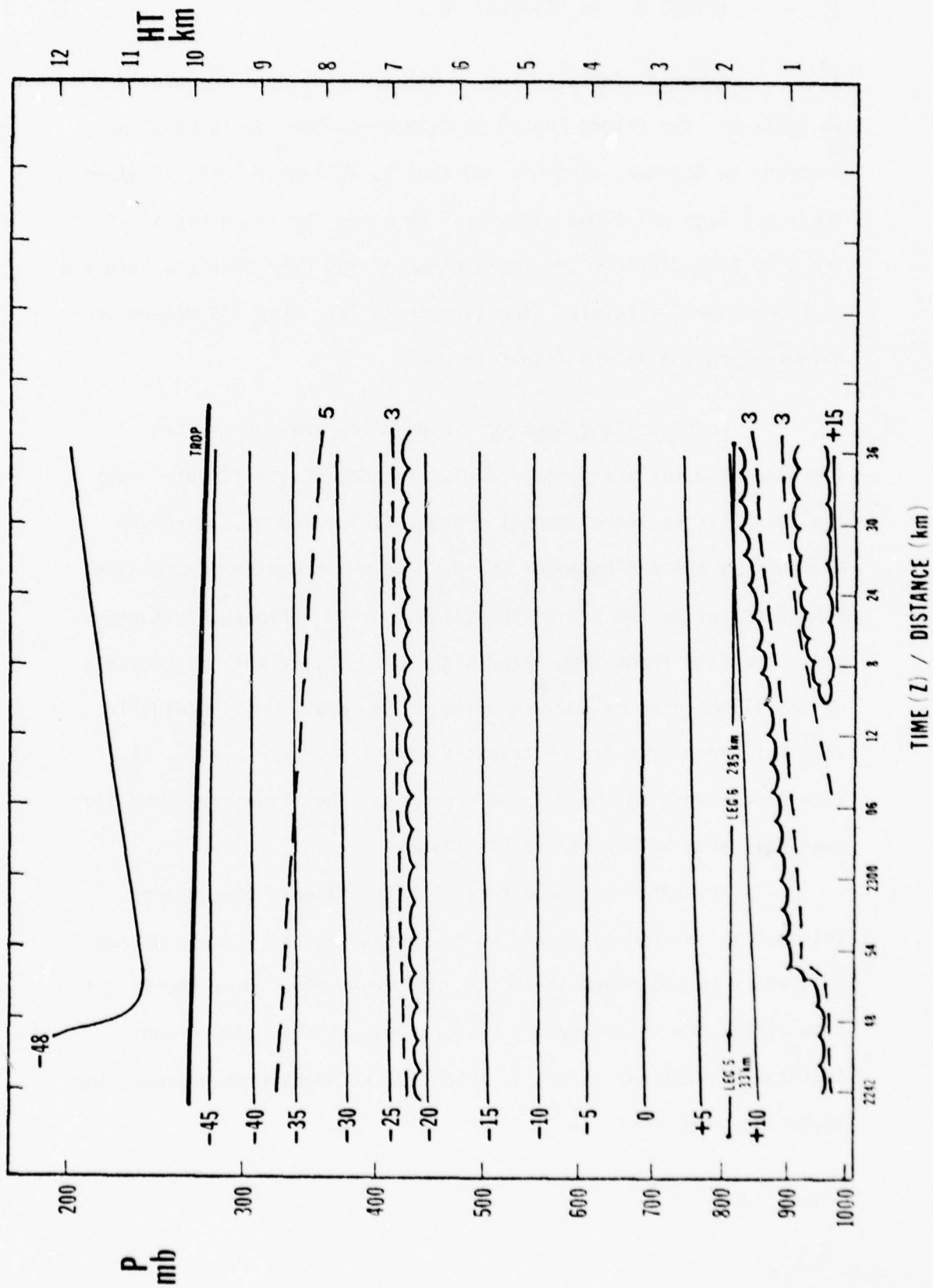


FIGURE 37. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEGS 5 AND 6 - 23 FEB 77 ANALYSIS

3. FLIGHT 2 24 FEBRUARY 1977

3.1 Aircraft Tracks. The flight tracking data are provided in Table 2. The flight begins at Raleigh-Durham, North Carolina, proceeds to Norfolk, Virginia and then to Wallops Island, Virginia. Ten short legs are flown within 115 km along the south radial of the Snow Hill VORTAC. The last leg goes from Cape Charles, Virginia to Front Royal, Virginia. The terrain is less than 135 meters in height along the inland flight tracks.

3.2 Local Surface Summary. A deep low pressure system dominates the surface picture during the day of the flight. This low, with its occluded frontal system, is located over northern Missouri at the beginning of the day and moves northeastward over Lake Superior by the end of the flight period (Figures 38 through 41). The cold front associated with the low lies well to the west of the flight area at the beginning of the day. Moist southerly flow influences the flight tracks during the entire period. As time progresses, the cold front approaches the flight area and lies over this area by the end of the flight.

Prior to the commencement of the flight, the area of interest is covered by scattered to broken clouds (Figures 42 and 43), which become overcast as the cold front moves over the flight area during the flight period (Figures 44 and 45). The clouds increase in vertical extent as a band of thunderstorms precedes the advancing cold front.

TABLE 2. AIRCRAFT TRACKS - 24 FEB 77

LEG	TIME (Z)		ALTITUDE ft (m)	POSITION		DISTANCE nm (km)
	START	STOP		BEGIN	END	
1	1900	1930	19,000 (5791)	RDU ¹	ORF ²	137 (254)
2	1930	1943	19,000 (5791)	ORF	WAL ³	68 (126)
3	2021	2025	13,000 (3962)	40 nm S SNO ⁴	29 nm S SNO	11 (20)
4	2037	2041	15,000 (4572)	43 nm S SNO	31 nm S SNO	12 (22)
5	2055	2059	10,000 (3048)	20 nm S SNO	8 nm S SNO	12 (22)
6	2112	2116	13,000 (3962)	43 nm S SNO	54 nm S SNO	11 (20)
7	2128	2132	16,000 (4877)	34 nm S SNO	45 nm S SNO	11 (20)
8	2155	2159	13,000 (3962)	26 nm S SNO	37 nm S SNO	11 (20)
9	2202	2204	13,000 (3962)	40 nm S SNO	46 nm S SNO	6 (11)
10	2214	2218	17,000 (5182) -19,000 (5791)	40 nm S SNO	28 nm S SNO	12 (22)
11	2224	2232	21,000 (6401)	42 nm S SNO	15 nm S SNO	27 (50)
12	2315	2320	25,000 (7620)	50 nm S SNO	62 nm S SNO	12 (22)
13	2330	0020	22,000 (6706)	CCV ⁵	FRR ⁶	146 (270)

¹RDU = Raleigh-Durham, North Carolina (35°52'N 78°47'W)

²ORF = Norfolk, Virginia (36°54'N 76°12'W)

³WAL = Wallops Island, Virginia (37°56'N 75°28'W)

⁴SNO = Snow Hill, Maryland (38°03'N 75°28'W)

⁵CCV = Cape Charles, Virginia (37°21'N 76°00'W)

⁶FRR = Front Royal, Virginia (39°05'N 78°12'W)

The surface low extends vertically through the 300 mb level and is manifested as a trough at 200 mb. On the morning of the flight, a short wave trough moves toward the flight area and lies over the flight tracks at the end of the flight period. This short wave trough affects the flow at all upper levels.

At the 850 mb level, southerly winds of $15\text{--}20 \text{ msec}^{-1}$ affect the flight area (Figure 46). An isotach maximum lies just to the east of the flight area increasing the wind speeds over the flight tracks an average of 5 msec^{-1} by the end of the flight period (Figure 48). Warm moist air extends over the flight area during the flight period (Figures 47 and 49).

The low at the 700 mb level brings southerly flow over the flight region throughout the flight period (Figures 50 and 52). An area of 35 msec^{-1} winds passes over the flight area during this same time frame. Temperatures decrease as cold moist air extends over the flight through the period (Figures 51 and 53).

The flow at 500 mb resembles the flow at the lower levels. An isotach maximum of 50 msec^{-1} approaches the flight tracks from the west and is located over the southwest corner of the flight area by the end of the flight (Figures 54 and 56). Cold moist air moves over the flight tracks during the flight period (Figures 55 and 57). An area of upward vertical motion lies over the flight tracks on the morning of the flight and moves toward the east within the next 12 hours (Figures 58 and 59). Positive vorticity is advected over the area of the flight during the period.

At 300 mb, the low moves northeastward and deepens during the day of the flight. This is accompanied by increased wind speeds over the flight area (Figures 60 and 62). Warmer air is advected over the flight zone during the period at this level (Figures 61 and 63).

The trough at 200 mb causes west-southwesterly flow over the flight area (Figures 64 and 66). Winds increase in magnitude as the trough moves eastward and an isotach maximum approaches the flight region from the west during the course of the day. Warmer air accompanying the trough moves over the flight tracks and causes increased temperatures during the flight period (Figures 65 and 67).

The local surface charts (Figures 68 through 70) show the cold front approaching the flight area from the west at the beginning of the flight period and lying over the flight area by the end of the period. A wide band of precipitation accompanies the cold front with numerous thunderstorms ahead of the front.

The flight cross-sections for the first two legs (Figures 71 and 72) show the winds from the south-southwest at the lower levels veering and generally increasing in speed with altitude. At the outset, there are at least three cloud layers with the lowest cloud bases at 350 meters. As the flight progresses, the moist layer becomes thicker with increasing cumuloform build-up and thunderstorm development. Cloud bases decrease to 150-200 meters with tops extending to 8.7 km and higher. The freezing level is at 2.5 km at the start of leg 1 rising to 2.8 km by the end of leg 2.

The tropopause is complex with the first stable layer at 12.3 km and temperatures of -51°C . This first tropopause lowers by the end of the second leg of the flight to 10.4 km with temperatures of -48°C . A second stable layer (too high to be illustrated) occurs near 90 mb at the beginning of the flight. Toward the end of the second leg there are two stable layers, one at 15.0 km and the other at 16.5 km.

The next ten legs of the flight occur over water just off the Delmarva peninsula. Winds are from the southwest between 900 and 700 mb. The winds then back with increasing height and are south-southwesterly at 600 mb. The winds remain from this direction through 400 mb, then veer with height and become westerly above 250 mb (Figures 73, 75, and 77). A deep layer of moisture (Figures 74, 76 and 78) is indicative of the widespread shower and thunderstorm activity throughout this portion of the flight over water. Cloud bases are 330 meters or below. The freezing level is at 2.7 km with little change during this part of the flight. The tropopause is complex with three stable layers. The first tropopause is at 10.4 km with temperatures of -47°C at the beginning of leg 3 and gradually lowers to 10.2 km and temperatures of -43°C by the end of leg 12. Two more stable layers (too high for illustration) occur above 100 mb.

As the flight leaves the coastal area on the last leg of the flight, the wind cross-section (Figure 77) shows the winds at the lower level shifting from south-southwesterly to southwesterly

and weakening. Temperatures decrease crossing the frontal zone below 400 mb but increase above this level (Figure 78). As the flight leaves the precipitation area, the depth of the moist layer reduces rapidly. Clouds become shallower with bases at 1.0 km and tops at 2.1 km. The freezing level lowers from 2.8 km to 2.3 km across the front. The tropopause becomes indefinite in the vicinity of the frontal zone.

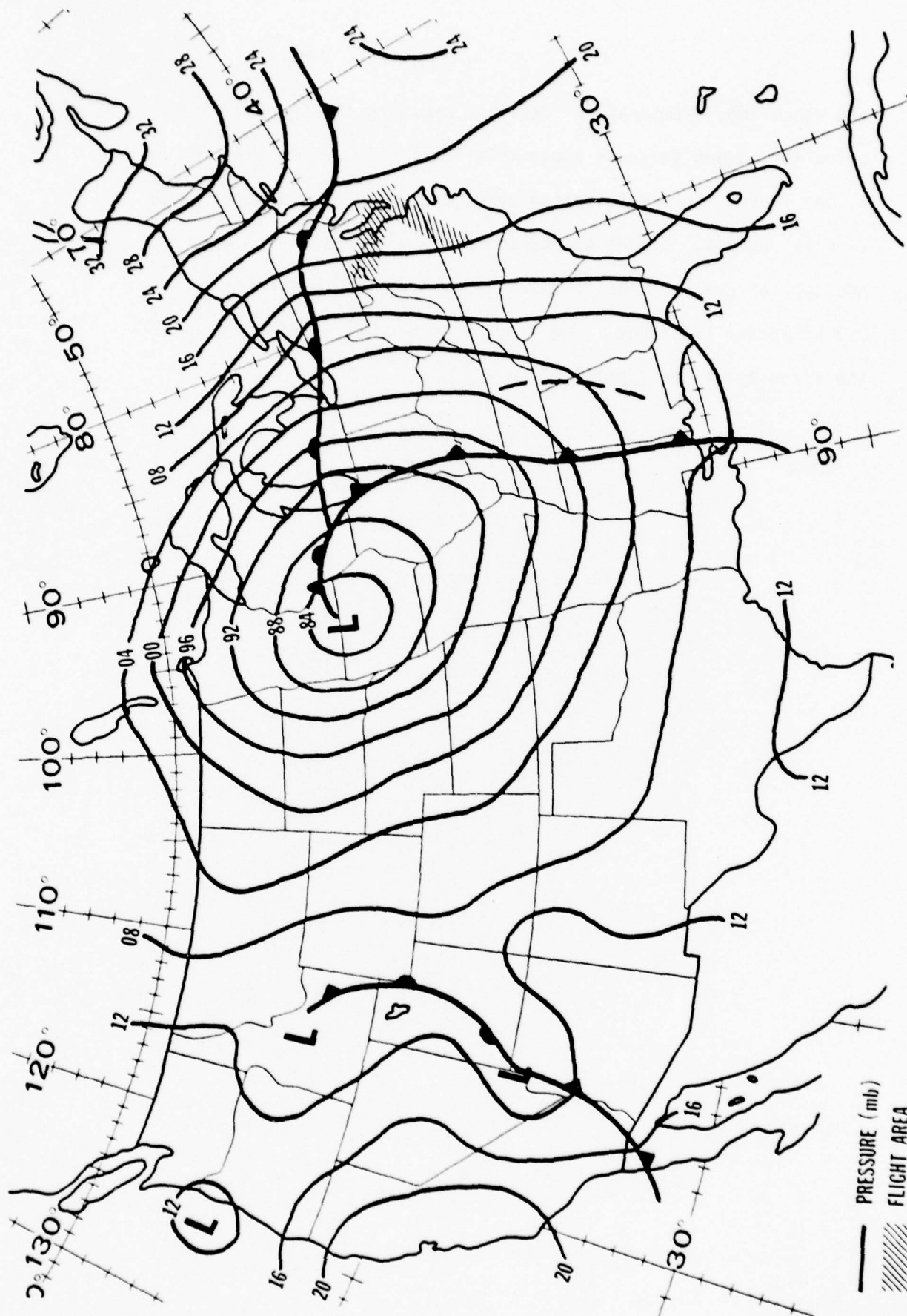


FIGURE 38. SURFACE PRESSURE - 24 FEB 77 06Z ANALYSIS

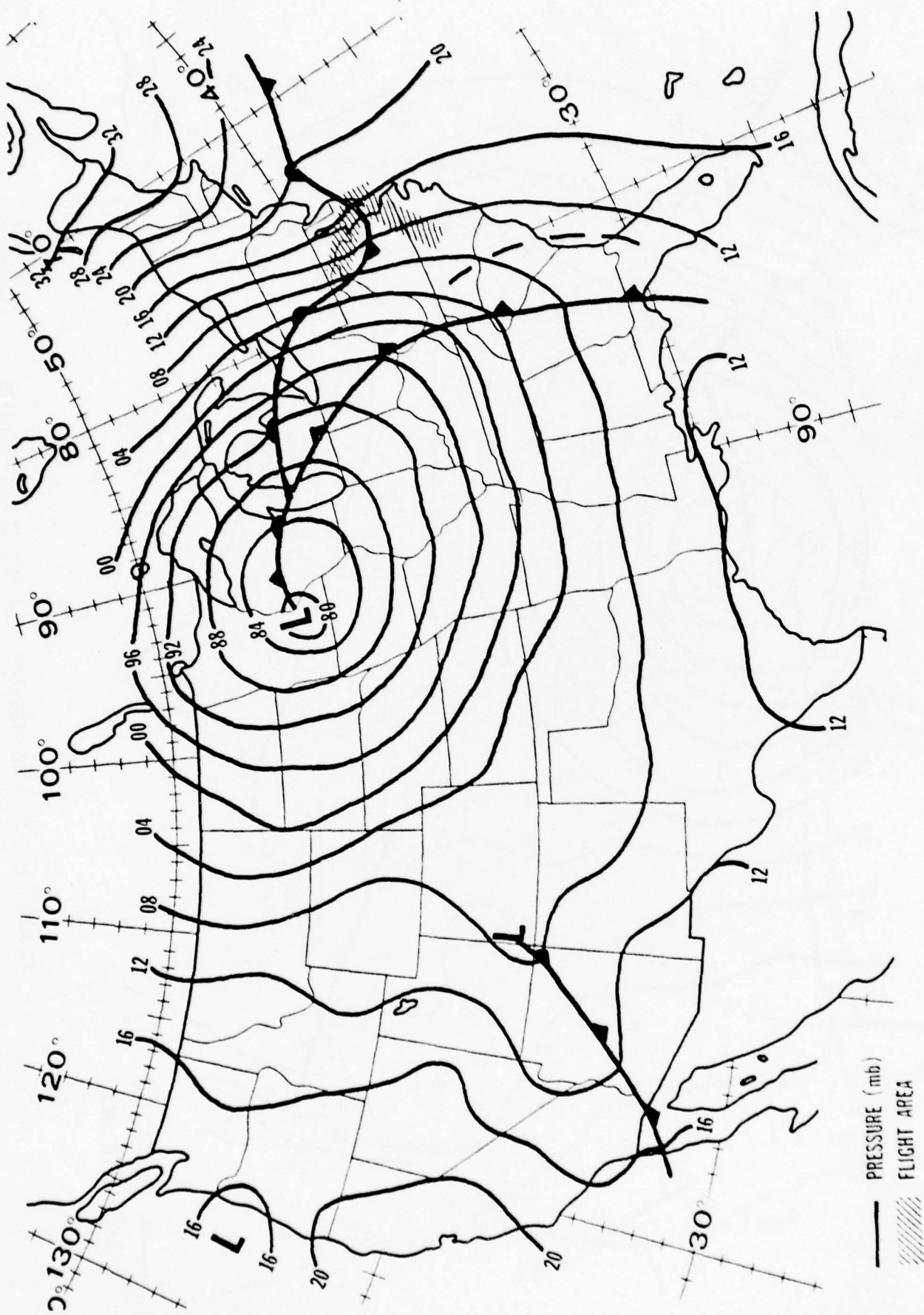


FIGURE 39. SURFACE PRESSURE - 24 FEB 77 12Z ANALYSIS

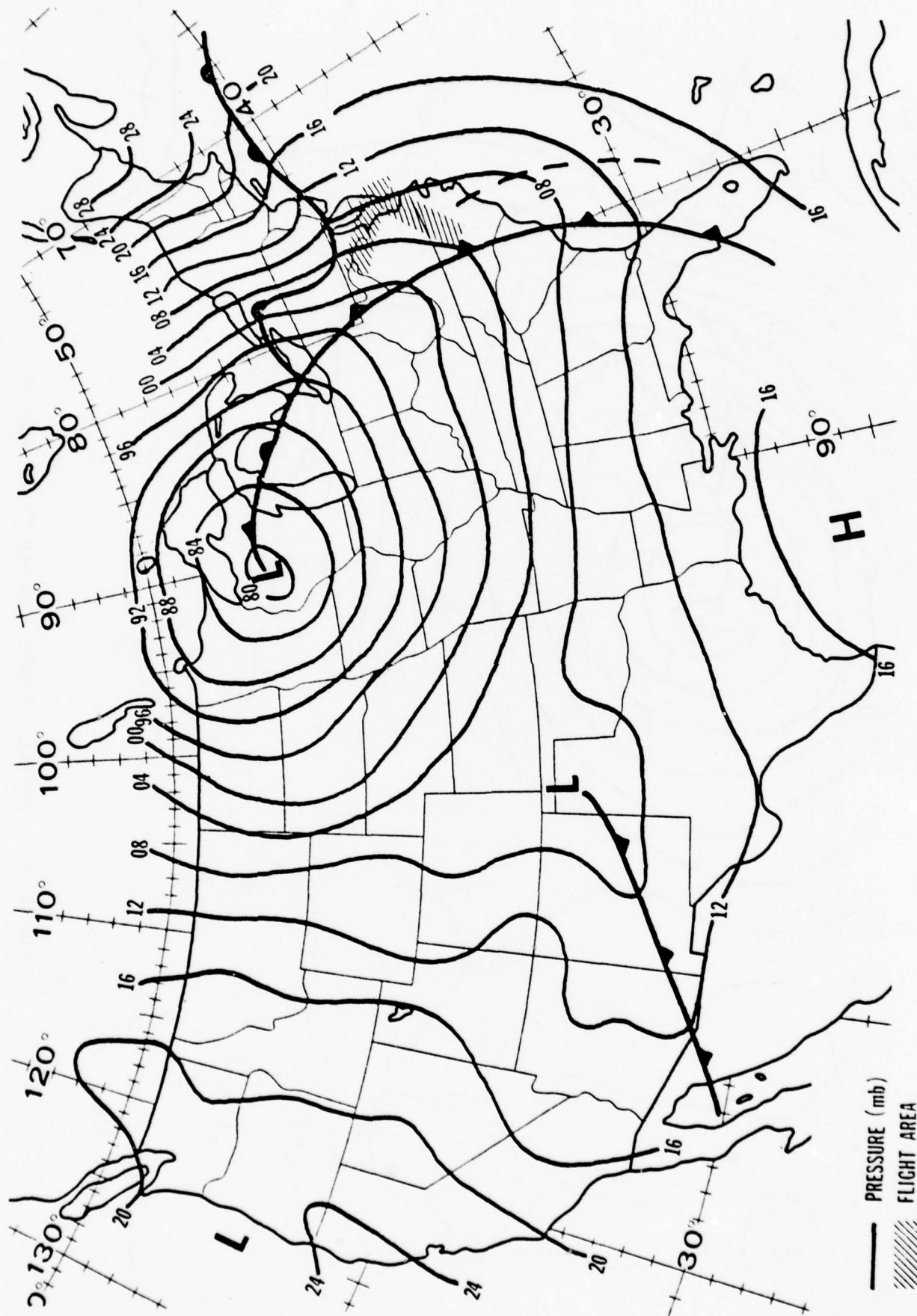


FIGURE 40. SURFACE PRESSURE - 24 FEB 77 18Z ANALYSIS

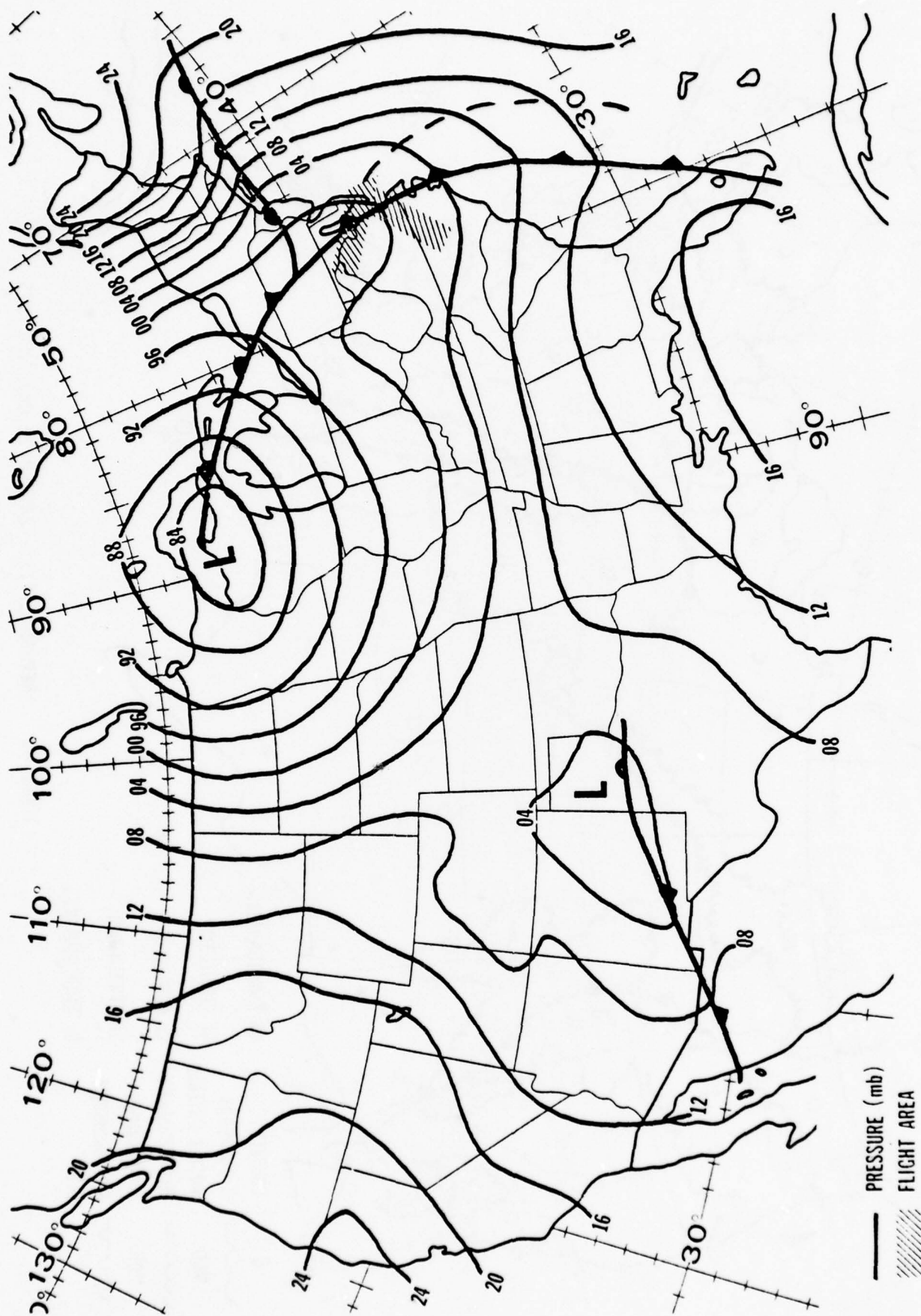


FIGURE 41. SURFACE PRESSURE - 25 FEB 77 00Z ANALYSIS

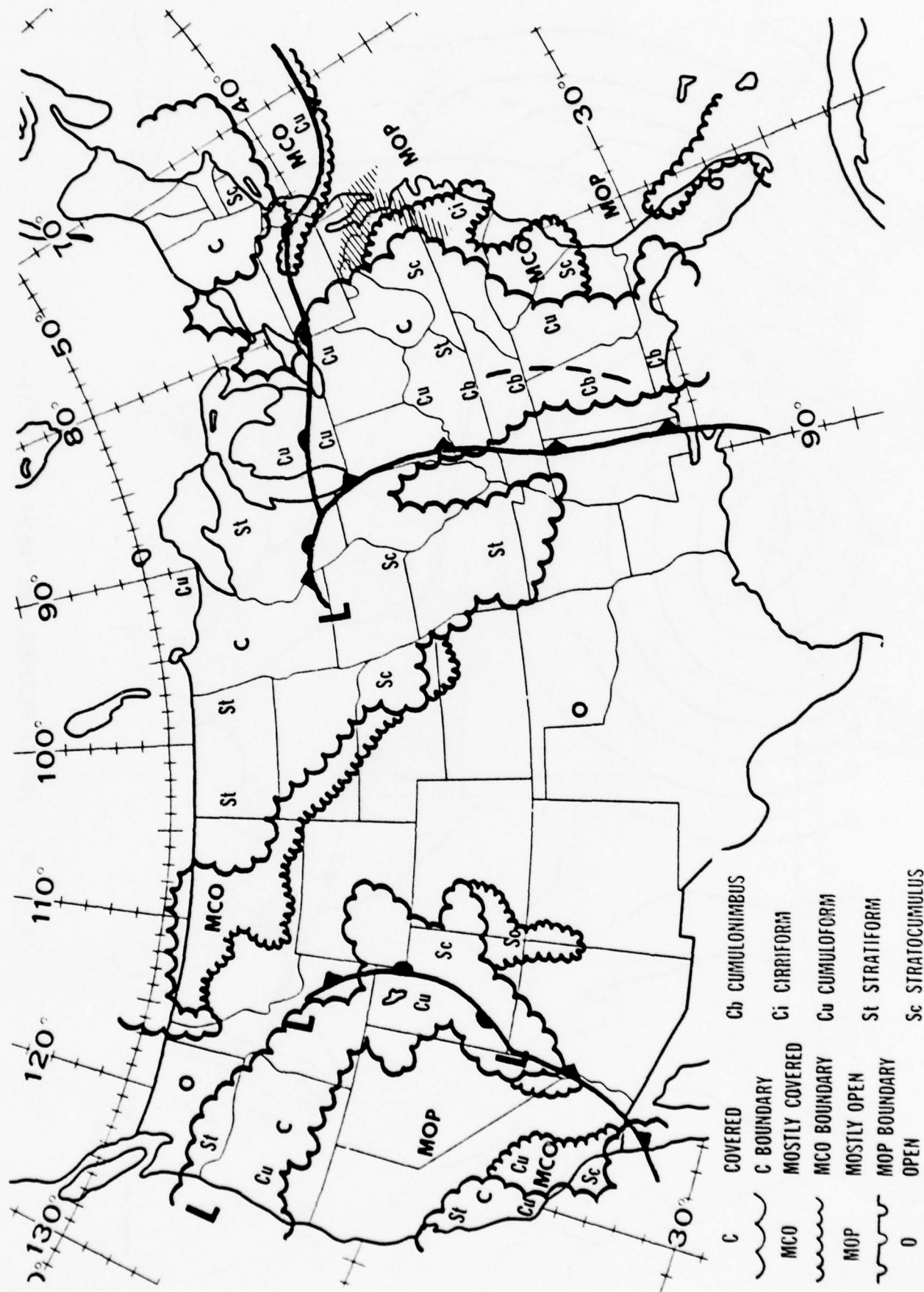


FIGURE 42. NEPAHALYSIS - 24 FEB 77 06Z ANALYSIS

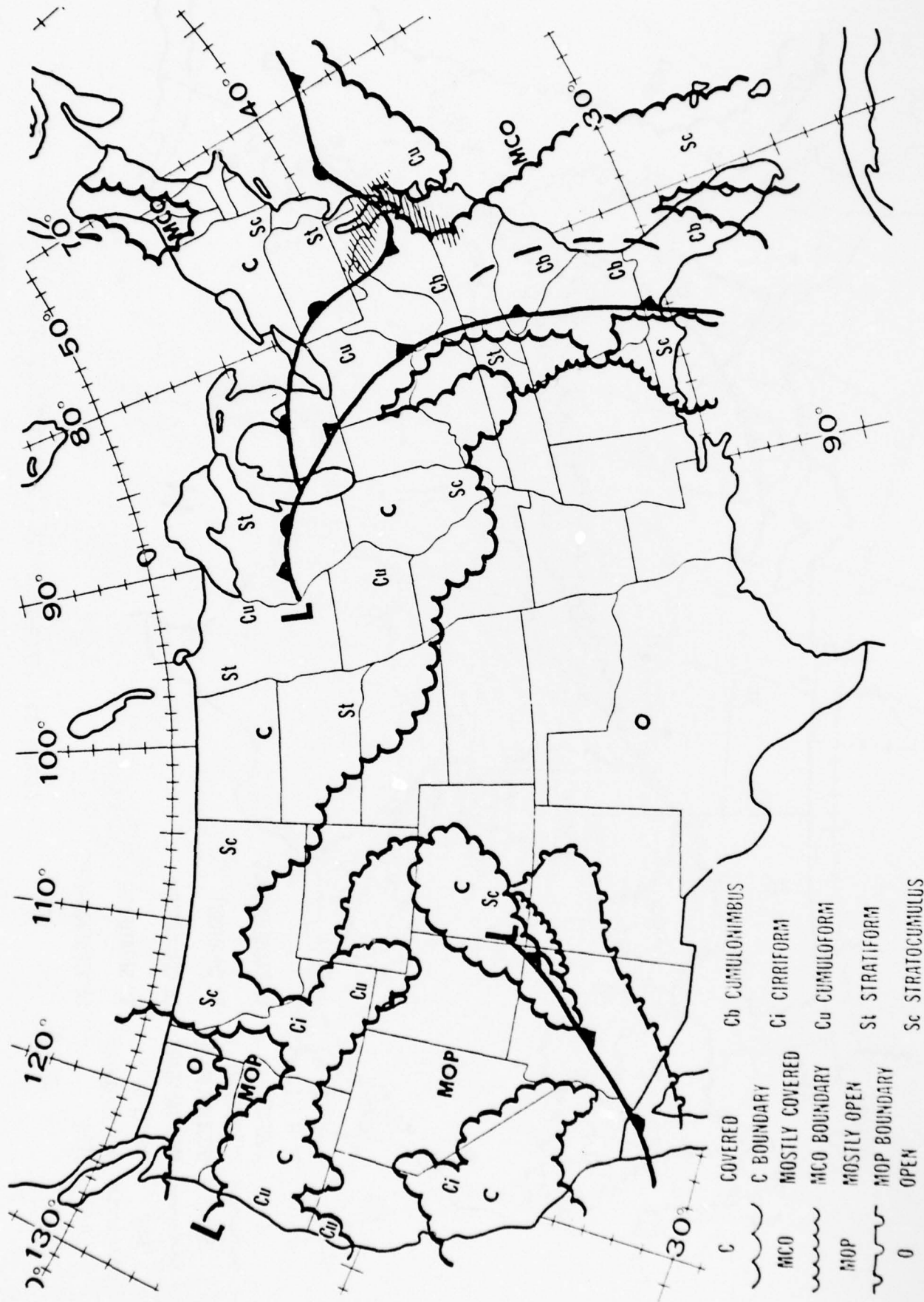


FIGURE 43. NEPHANALYSIS - 24 FEB 77 12Z ANALYSIS

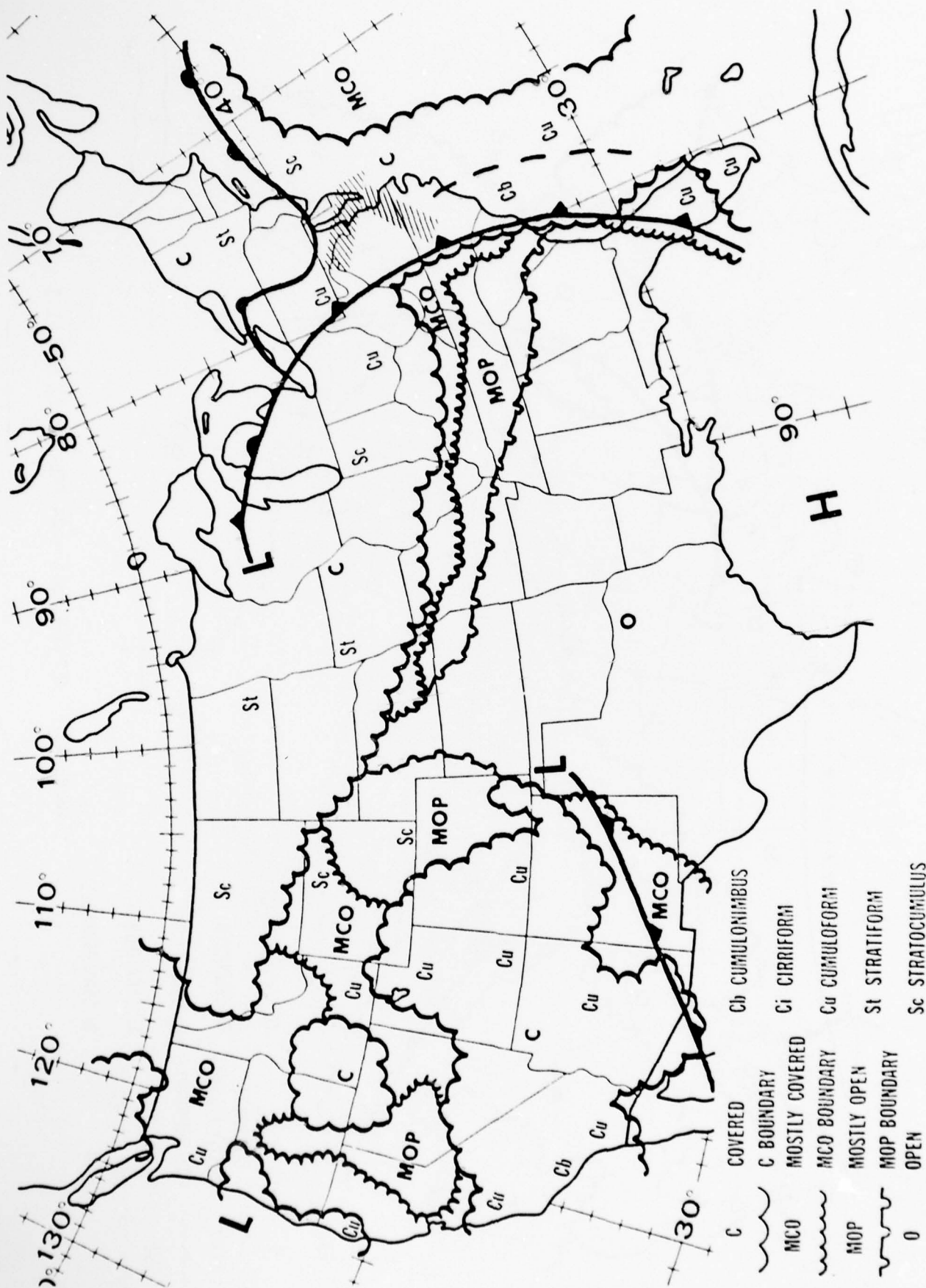


FIGURE 44. NEPHANALYSIS - 24 FEB 77 18Z ANALYSIS

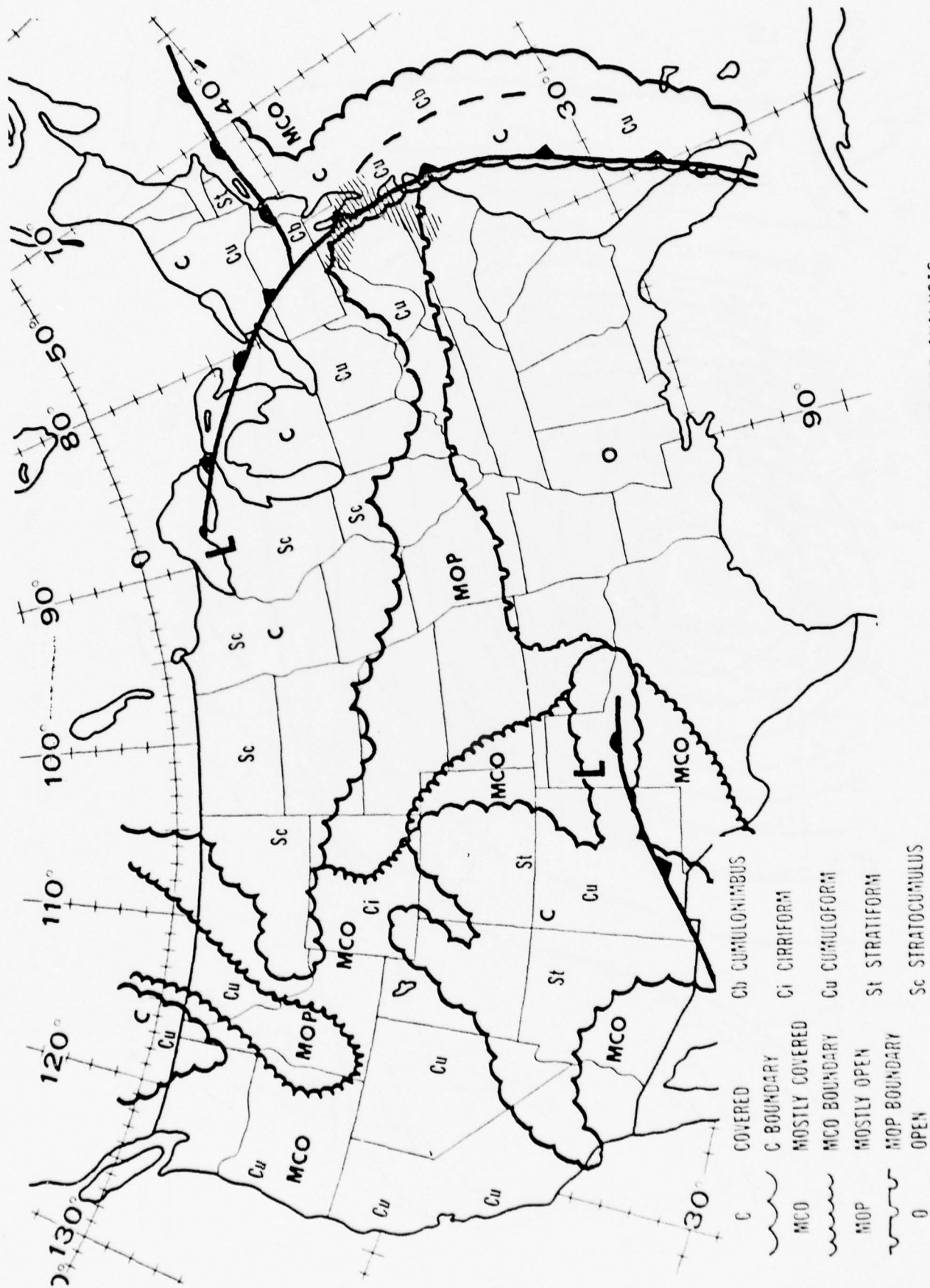


FIGURE 45. NEPHANALYSIS - 25 FEB 77 00Z ANALYSIS

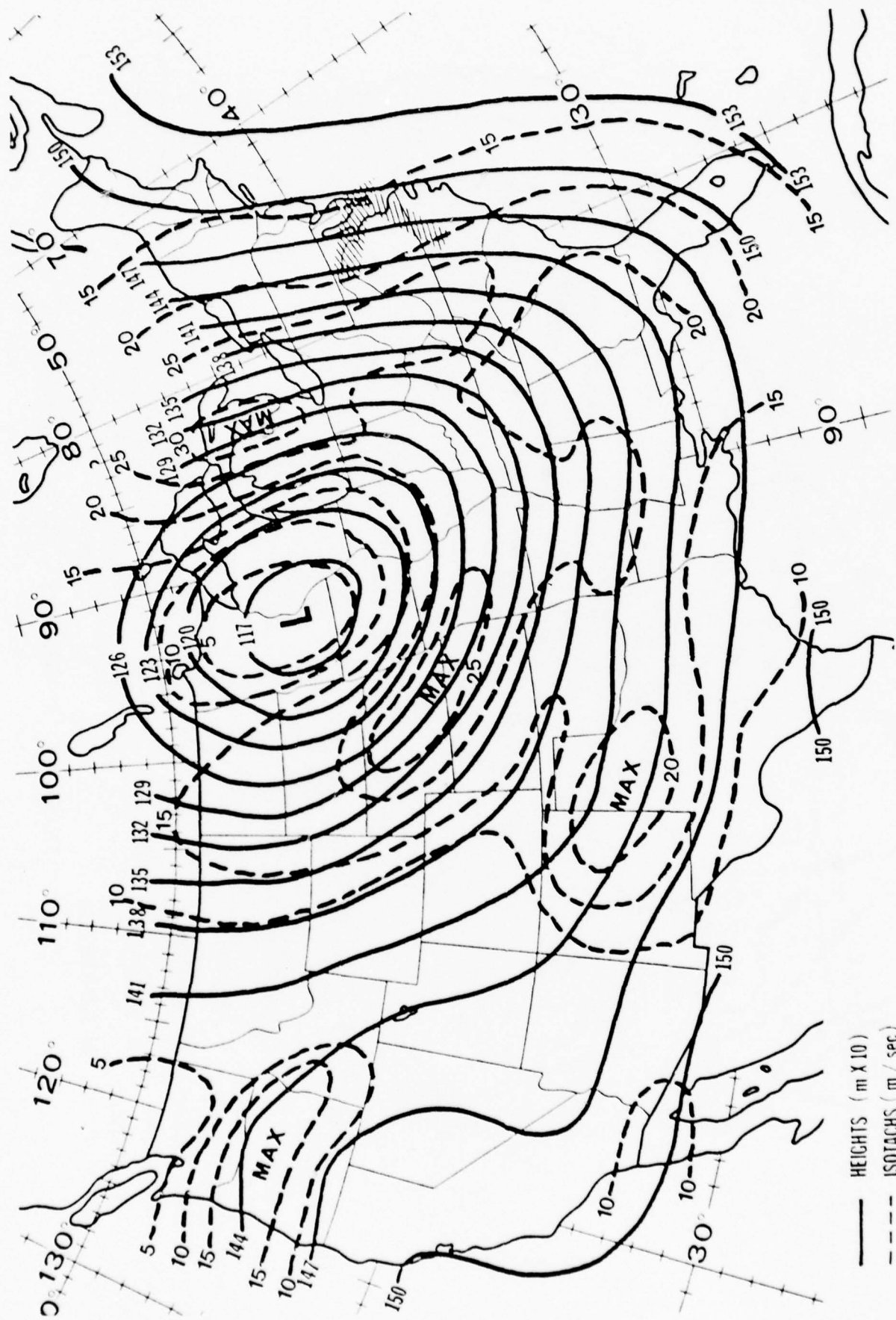


FIGURE 46. 850 mb HEIGHTS/ISOTHERMS - 24 FEB 77 12Z ANALYSIS

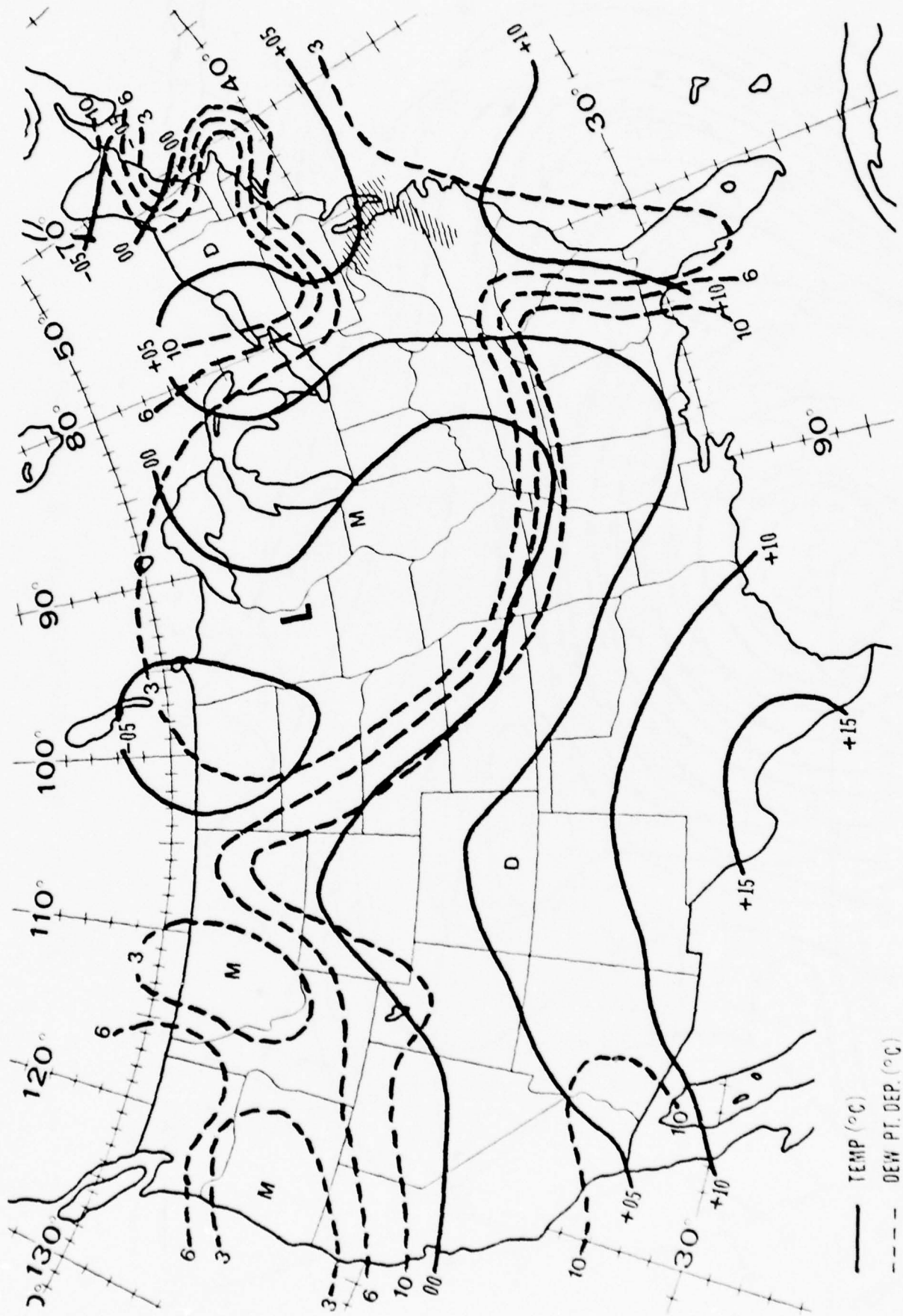


FIGURE 47. 850 mb TEMP./DEW PT. DEPRESSION - 24 FEB 77 12Z ANALYSIS

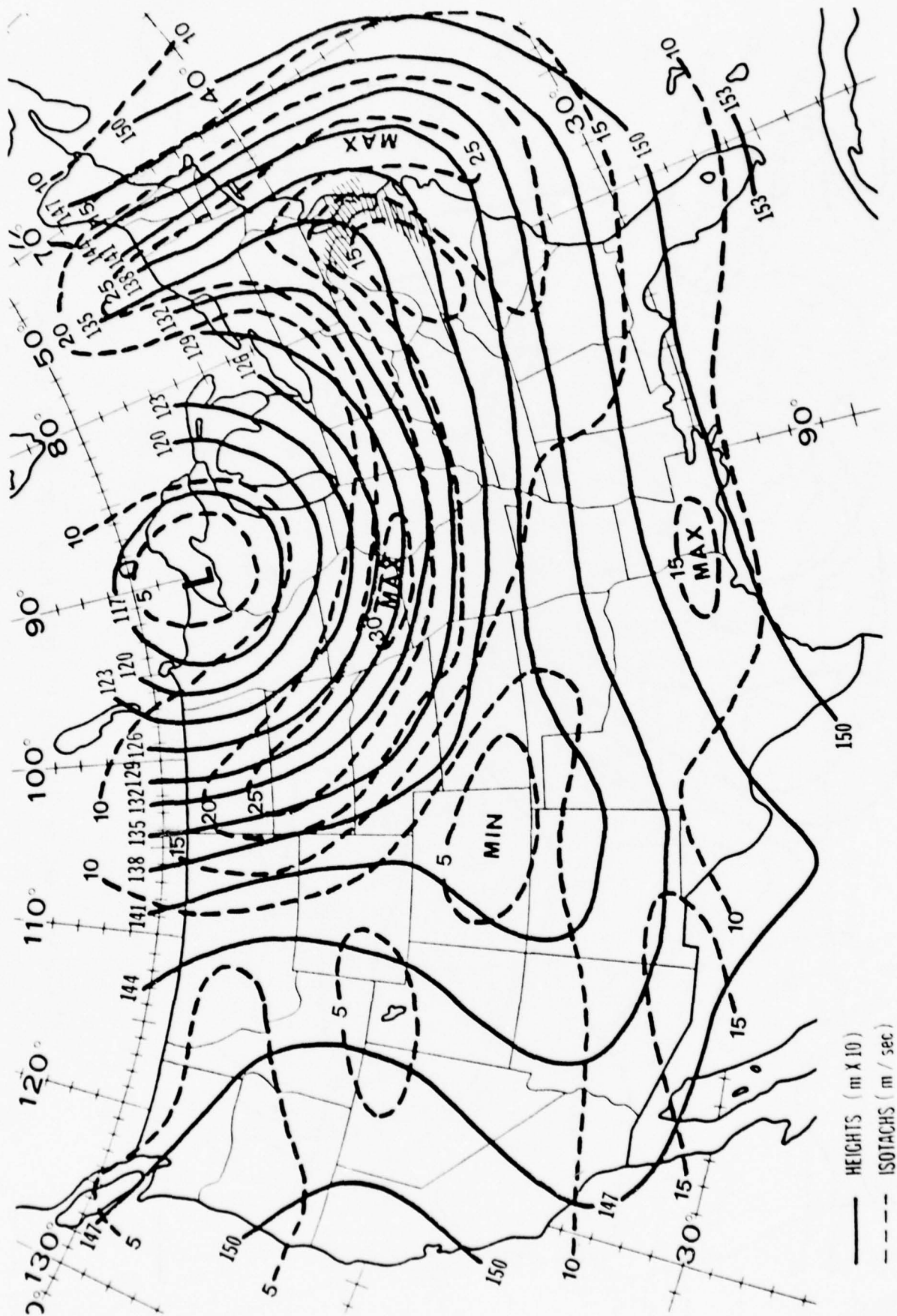


FIGURE 48. 850 mb HEIGHTS/ISOTACHS - 25 FEB 77 00Z ANALYSIS

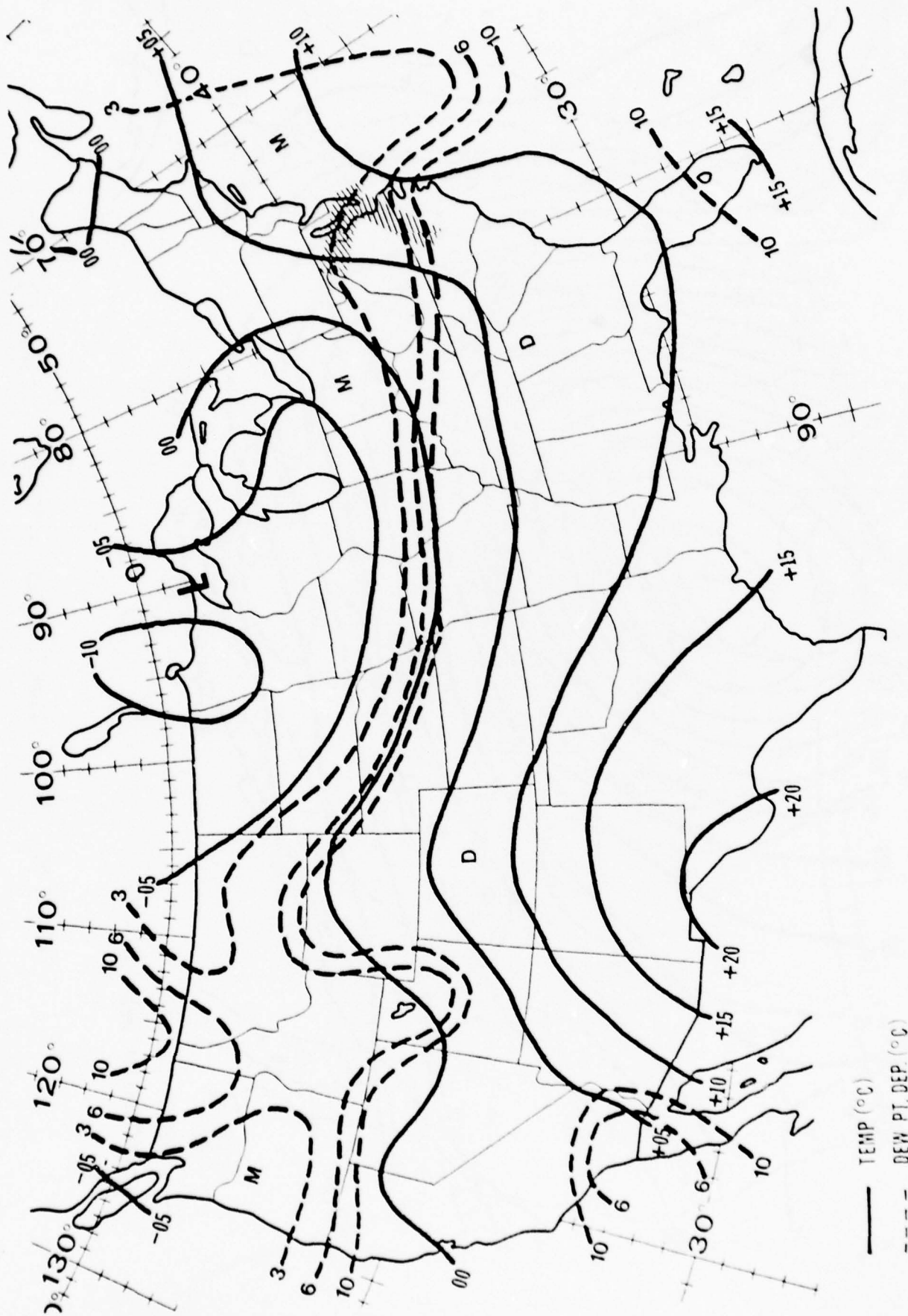


FIGURE 49. 850 mb TEMP./DEW PT. DEPRESSION - 25 FEB 77 00Z ANALYSIS

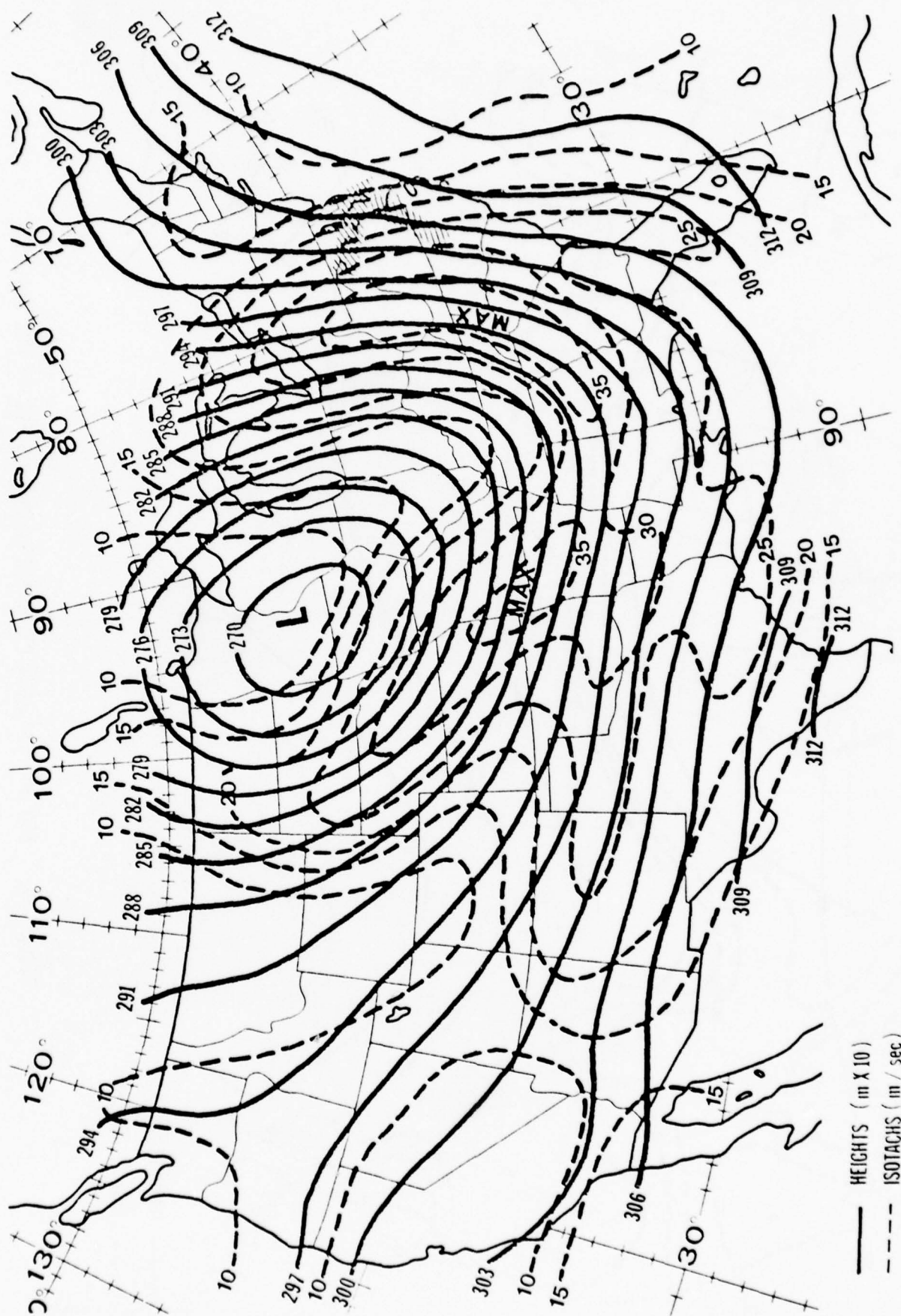


FIGURE 50. 700 mb HEIGHTS/ISOTACHS - 24 FEB 77 12Z ANALYSIS

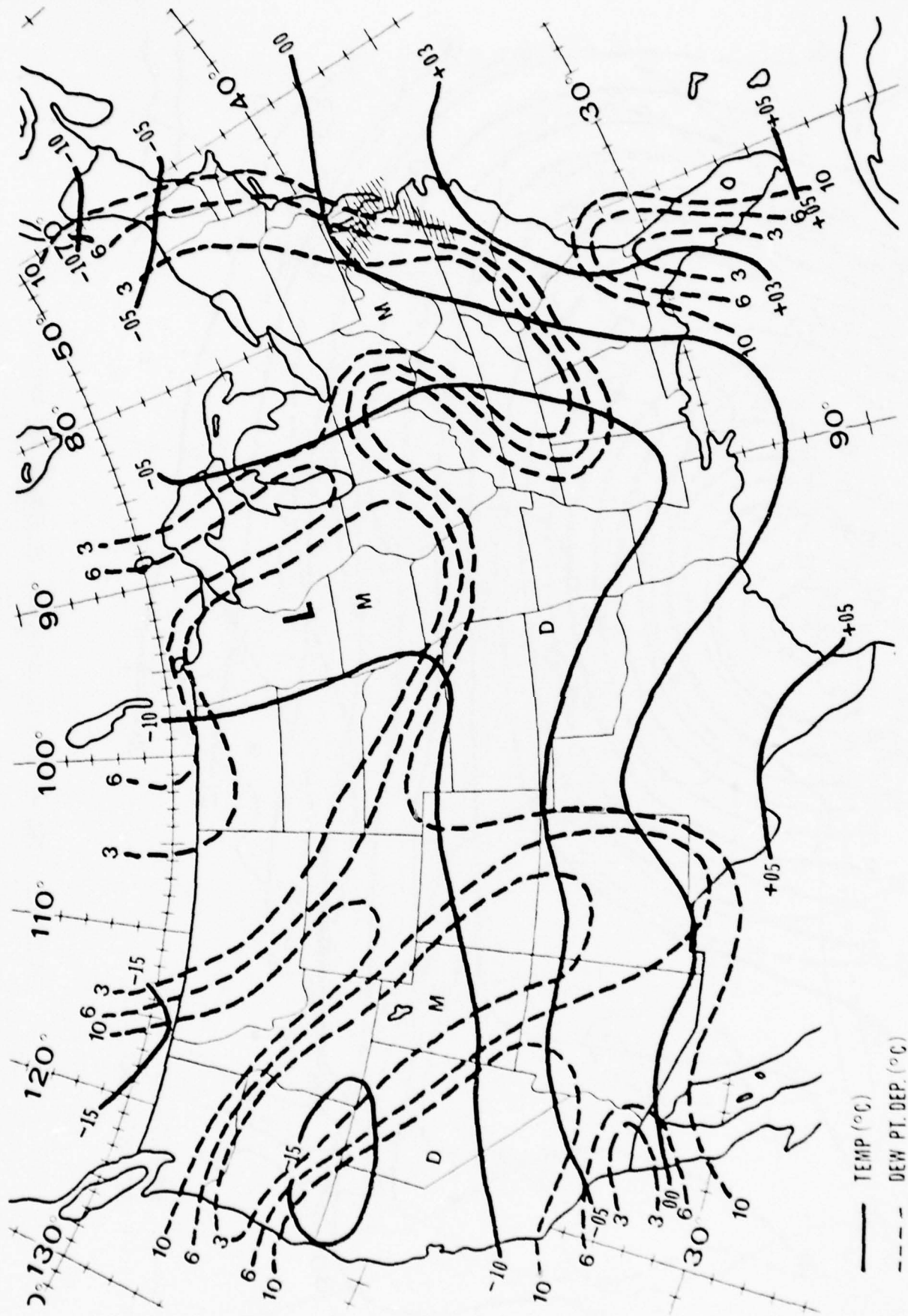


FIGURE 51. 700 mb TEMP./DEW PT. DEPRESSION - 24 FEB 77 12Z ANALYSIS

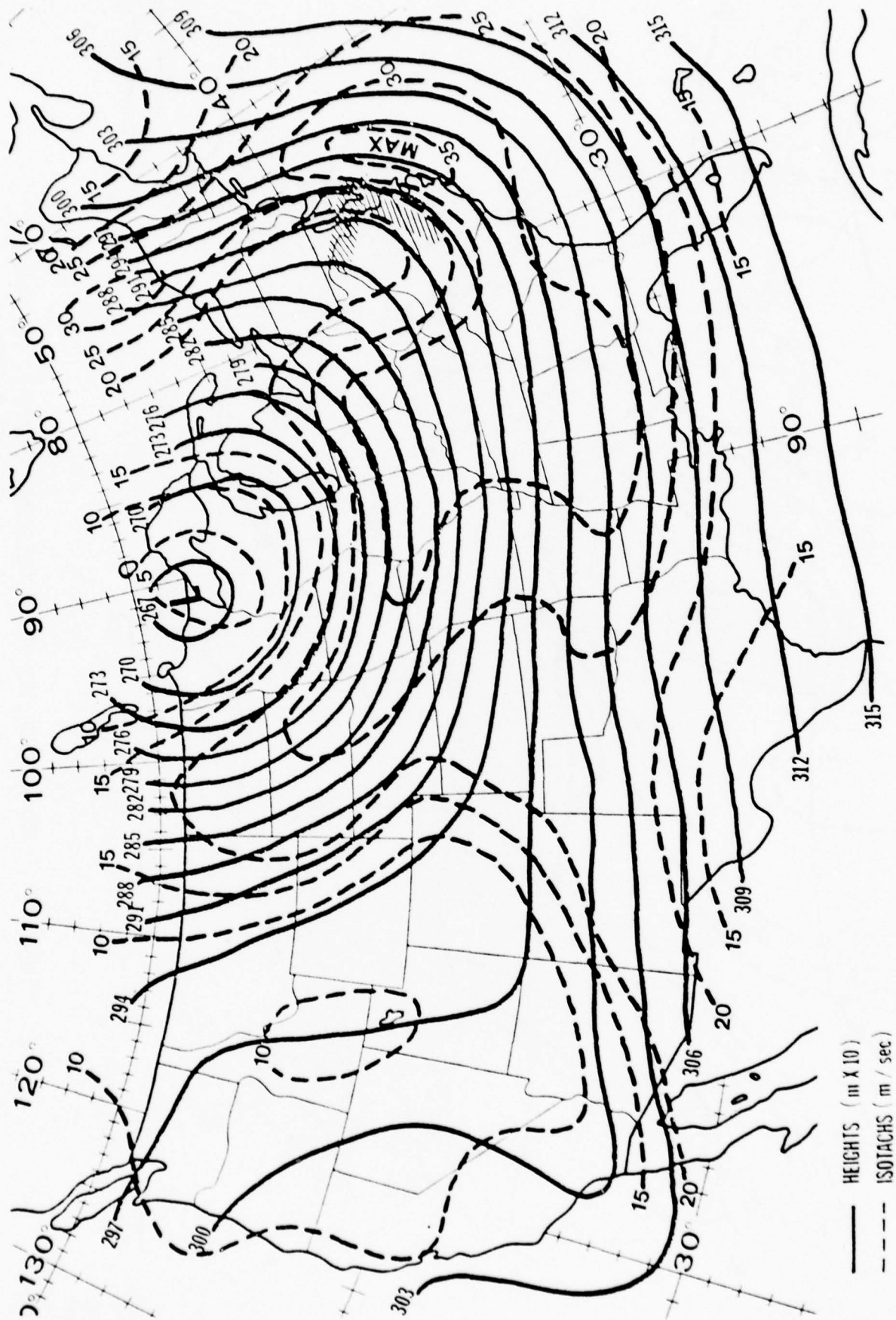


FIGURE 52. 700 mb HEIGHTS/ISOTACHS - 25 FEB 77 00Z ANALYSIS

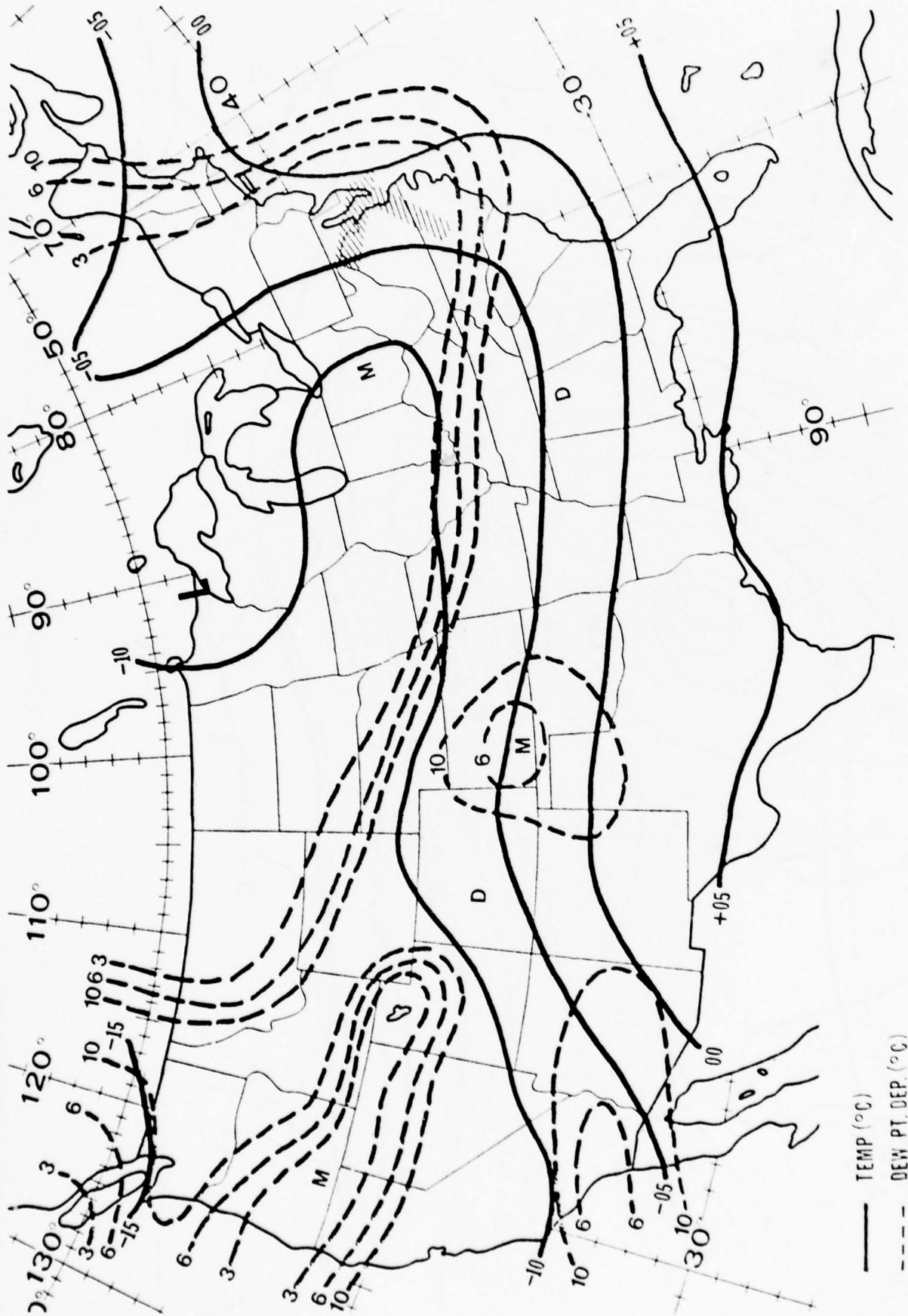


FIGURE 53. 700 mb TEMP./DEW PT. DEPRESSION - 25 FEB 77 00Z ANALYSIS

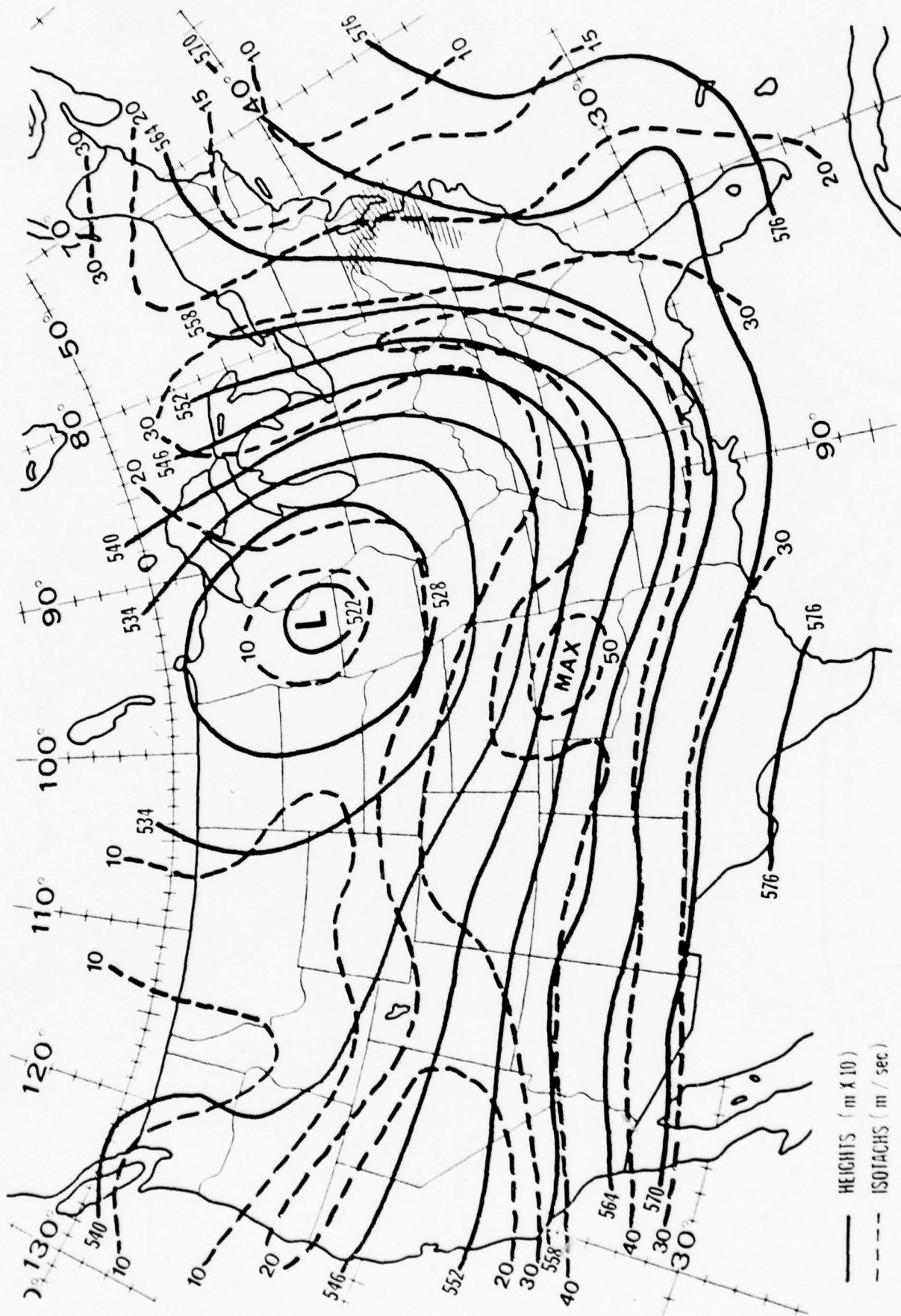


FIGURE 54. 500 mb HEIGHTS/ISOTACHS - 24 FEB 77 12Z ANALYSIS

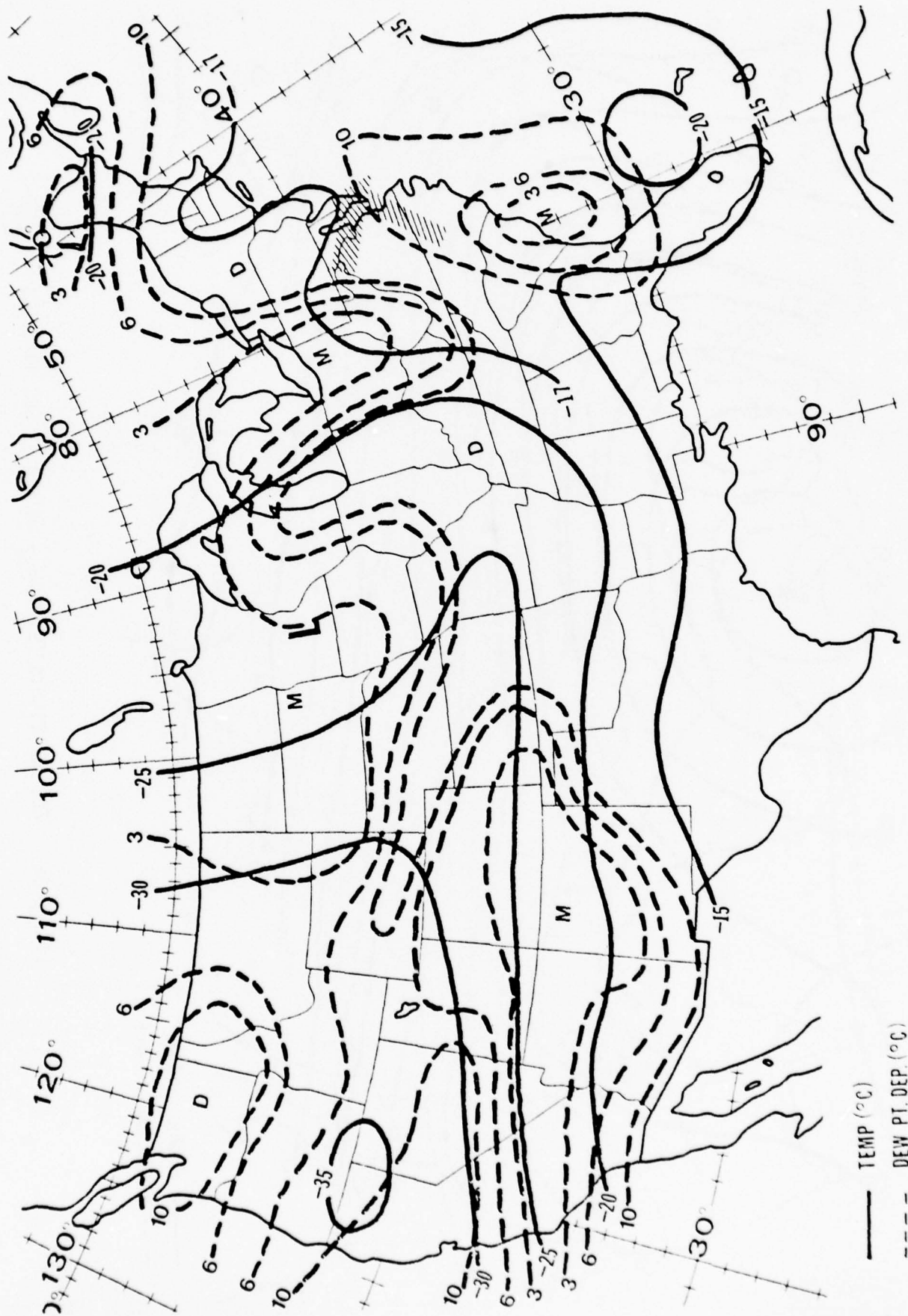


FIGURE 55. 500 mb TEMP./DEW PT. DEPRESSION - 24 FEB 77 12Z ANALYSIS

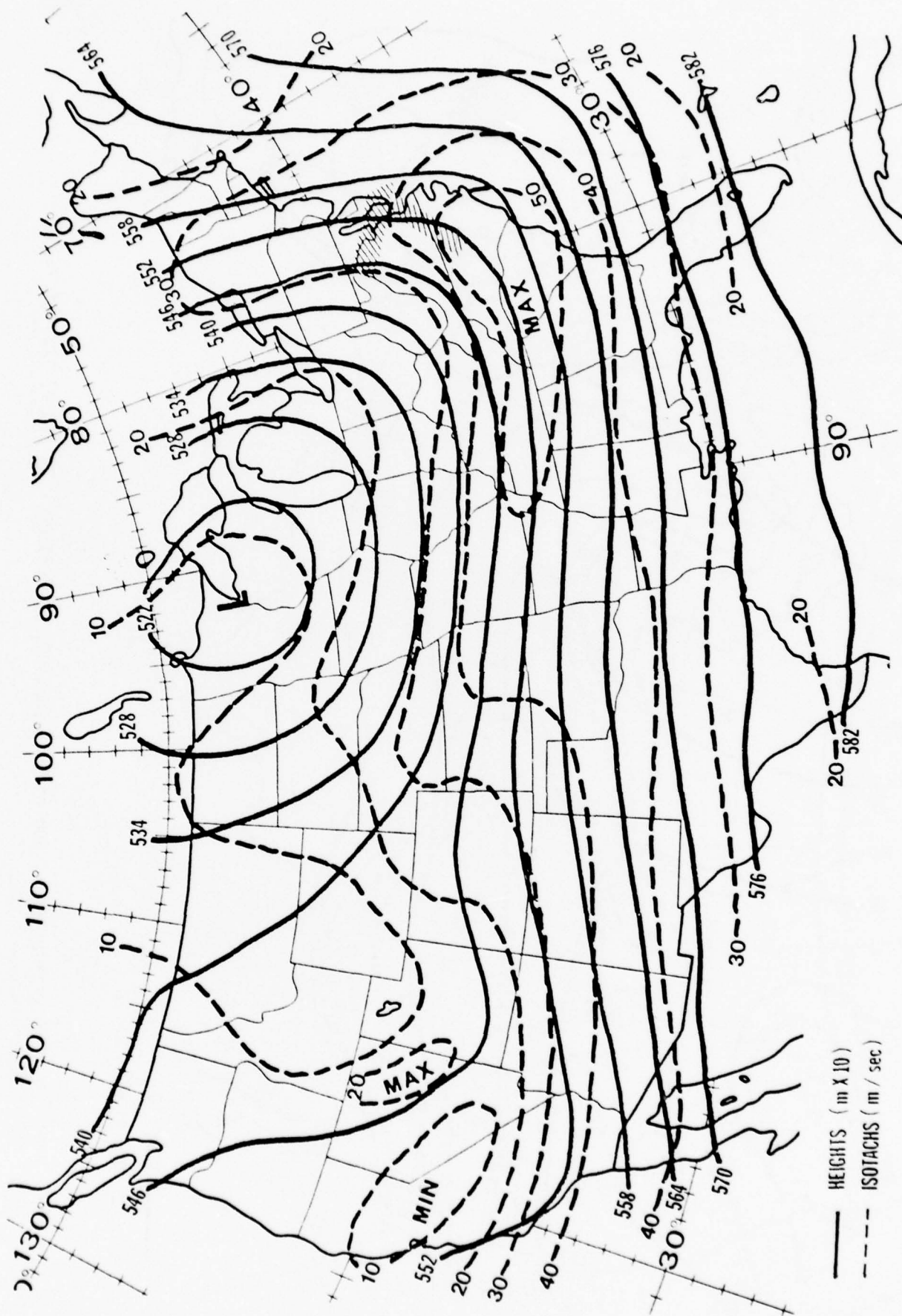


FIGURE 56. 500 mb HEIGHTS/ISOTACHS - 25 FEB 77 00Z ANALYSIS

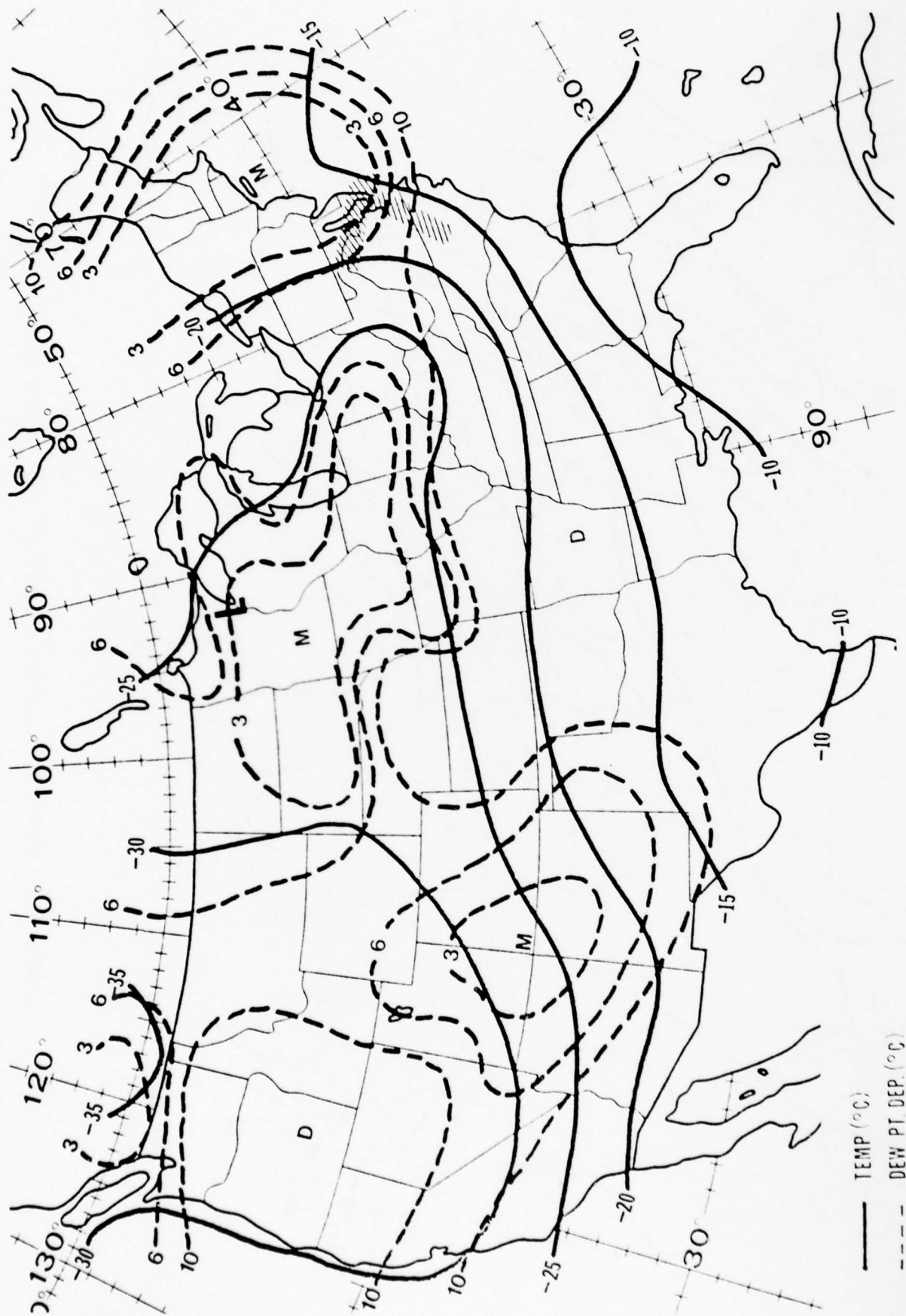


FIGURE 57. 500 mb TEMP./DEW PT. DEPRESSION - 25 FEB 77 00Z ANALYSIS

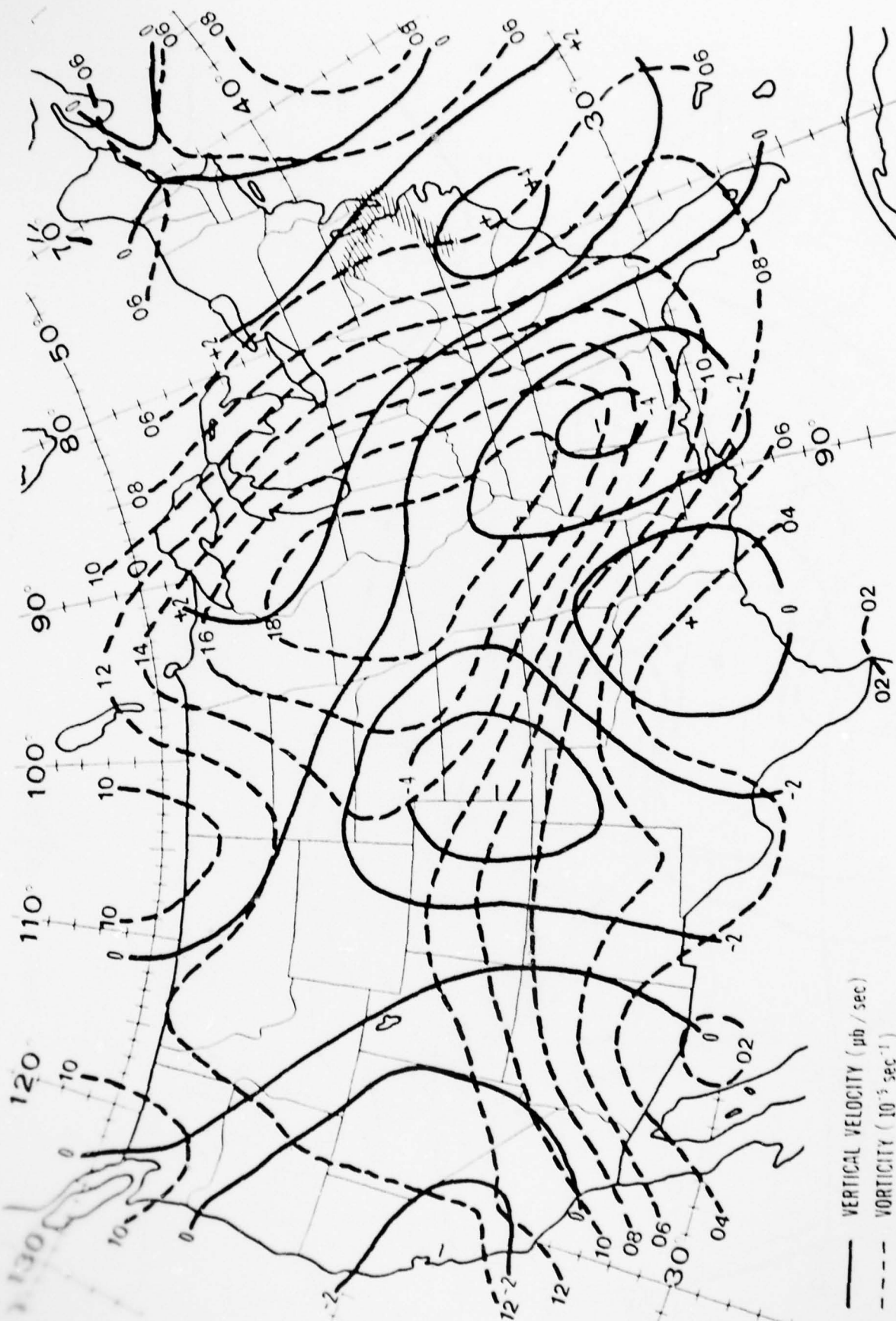


FIGURE 58. 500 mb VERT. VELOCITY/VORTICITY - 24 FEB 77 12Z ANALYSIS

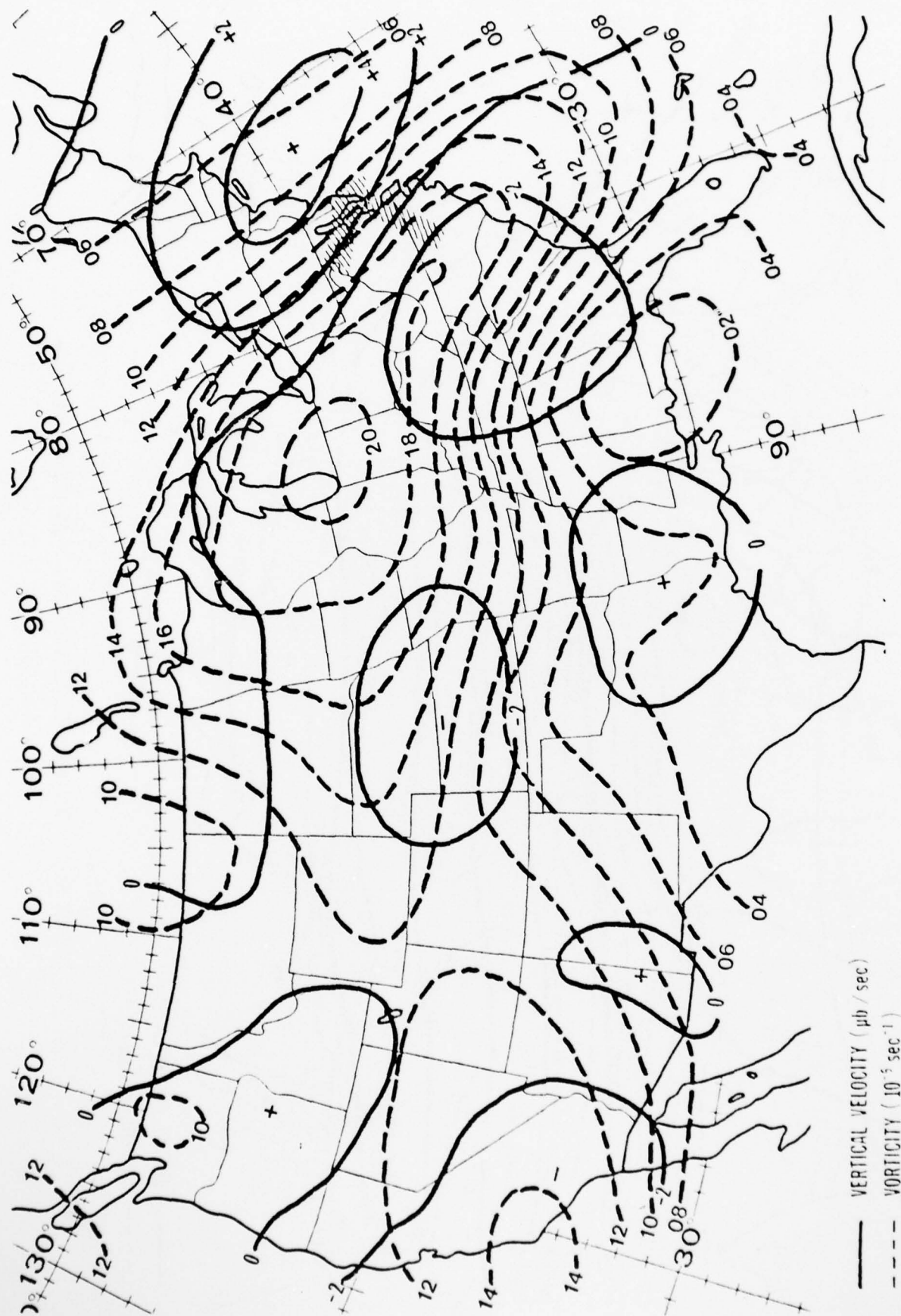


FIGURE 59. 500 mb VERT. VELOCITY/VORTICITY - 25 FEB 77 00Z ANALYSIS

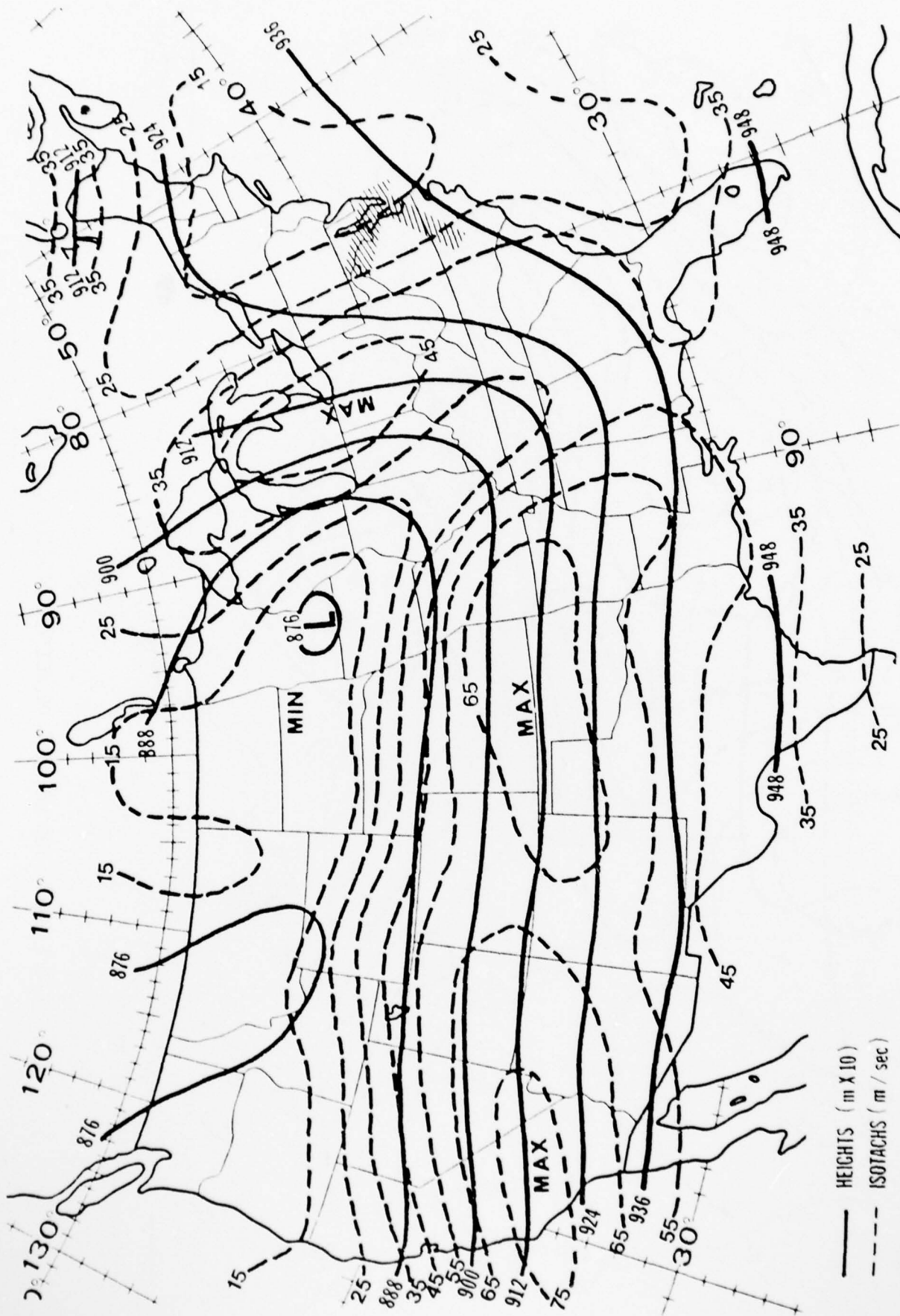


FIGURE 60. 300 mb HEIGHTS/ISOTACHS - 24 FEB 77 12Z ANALYSIS

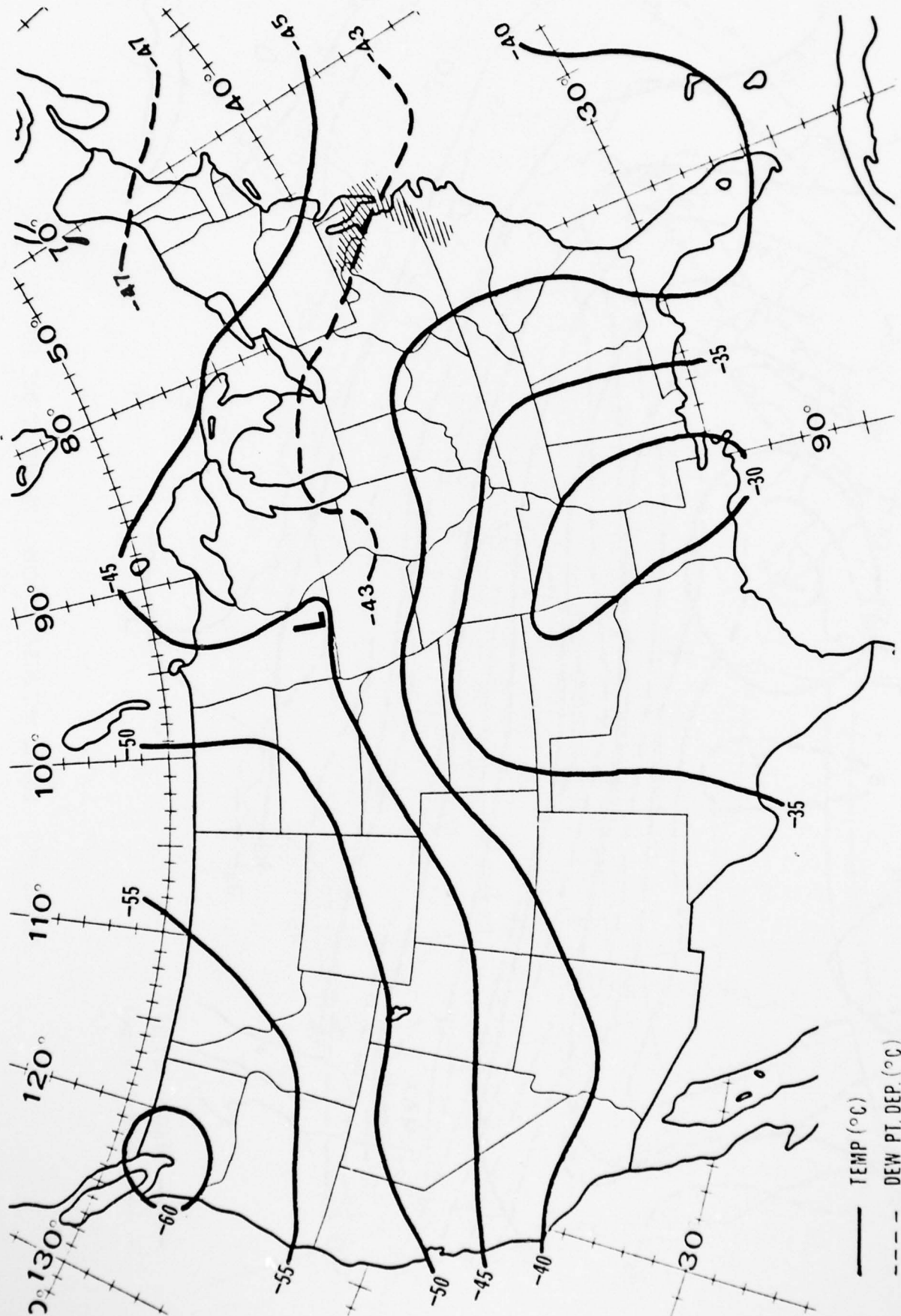


FIGURE 61. 300 mb TEMPERATURE - 24 FEB 77 12Z ANALYSIS

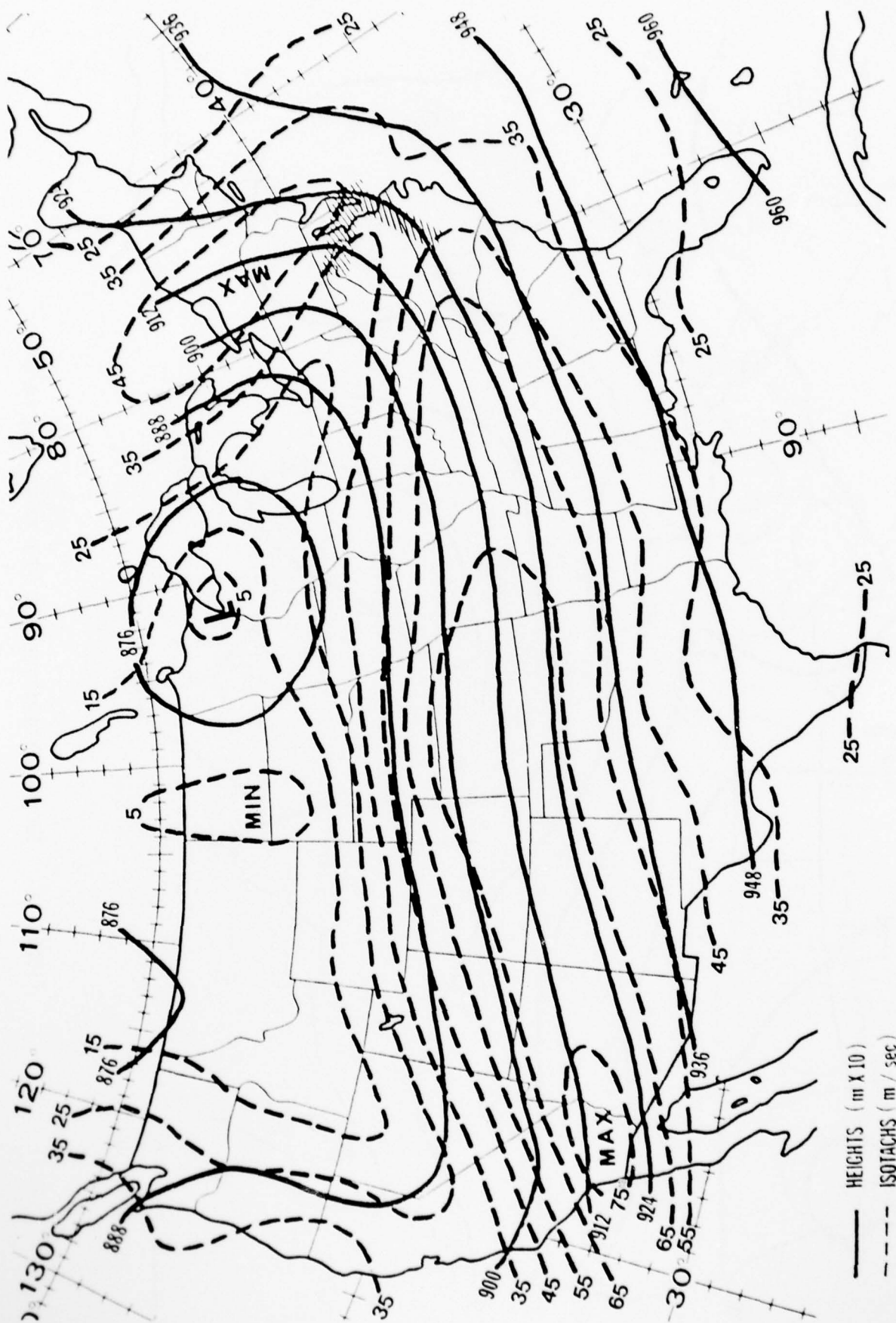


FIGURE 62. 300 mb HEIGHTS/ISOTACHS - 25 FEB 77 00Z ANALYSIS

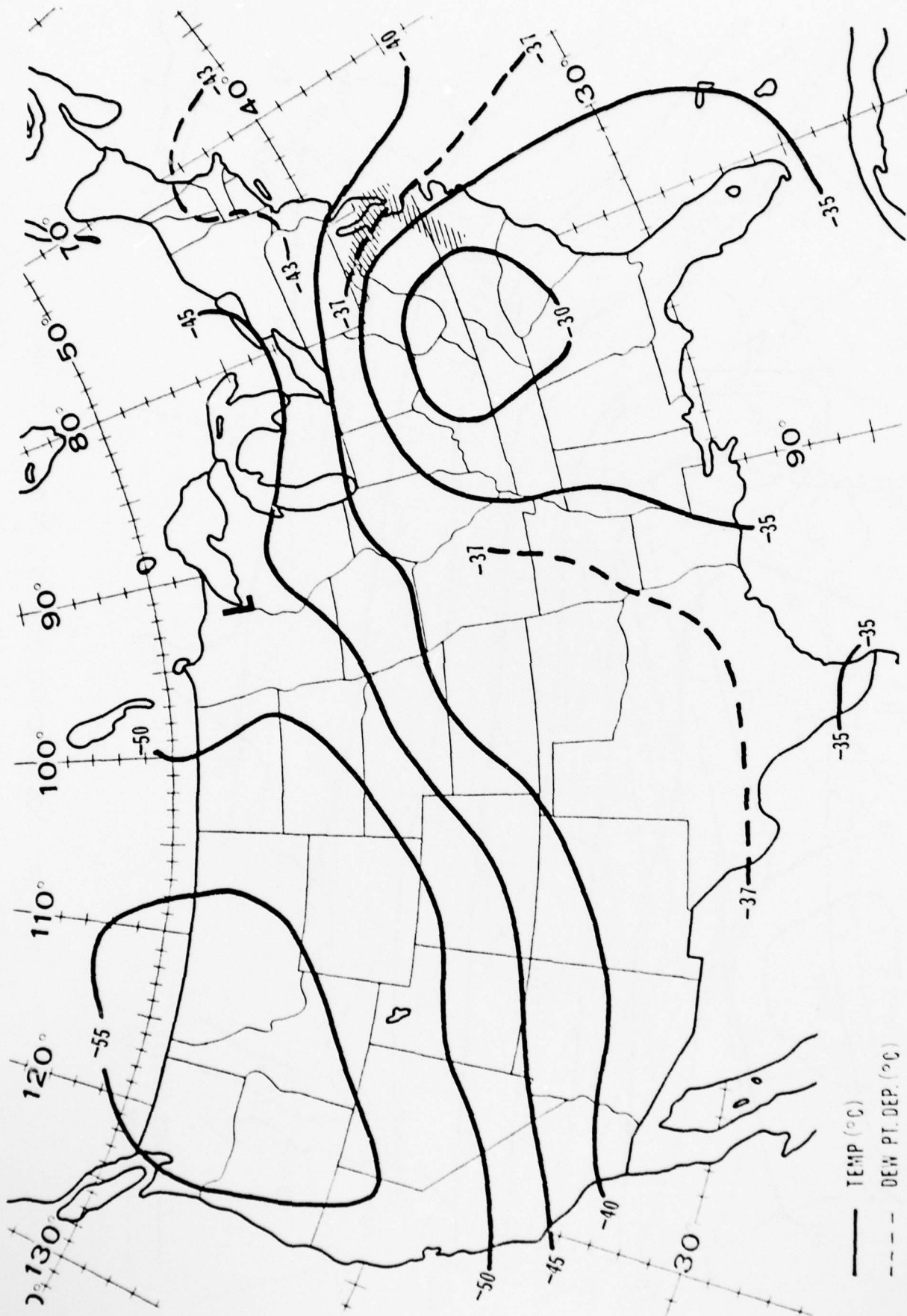


FIGURE 63. 300 mb TEMPERATURE - 25 FEB 77 00Z ANALYSIS

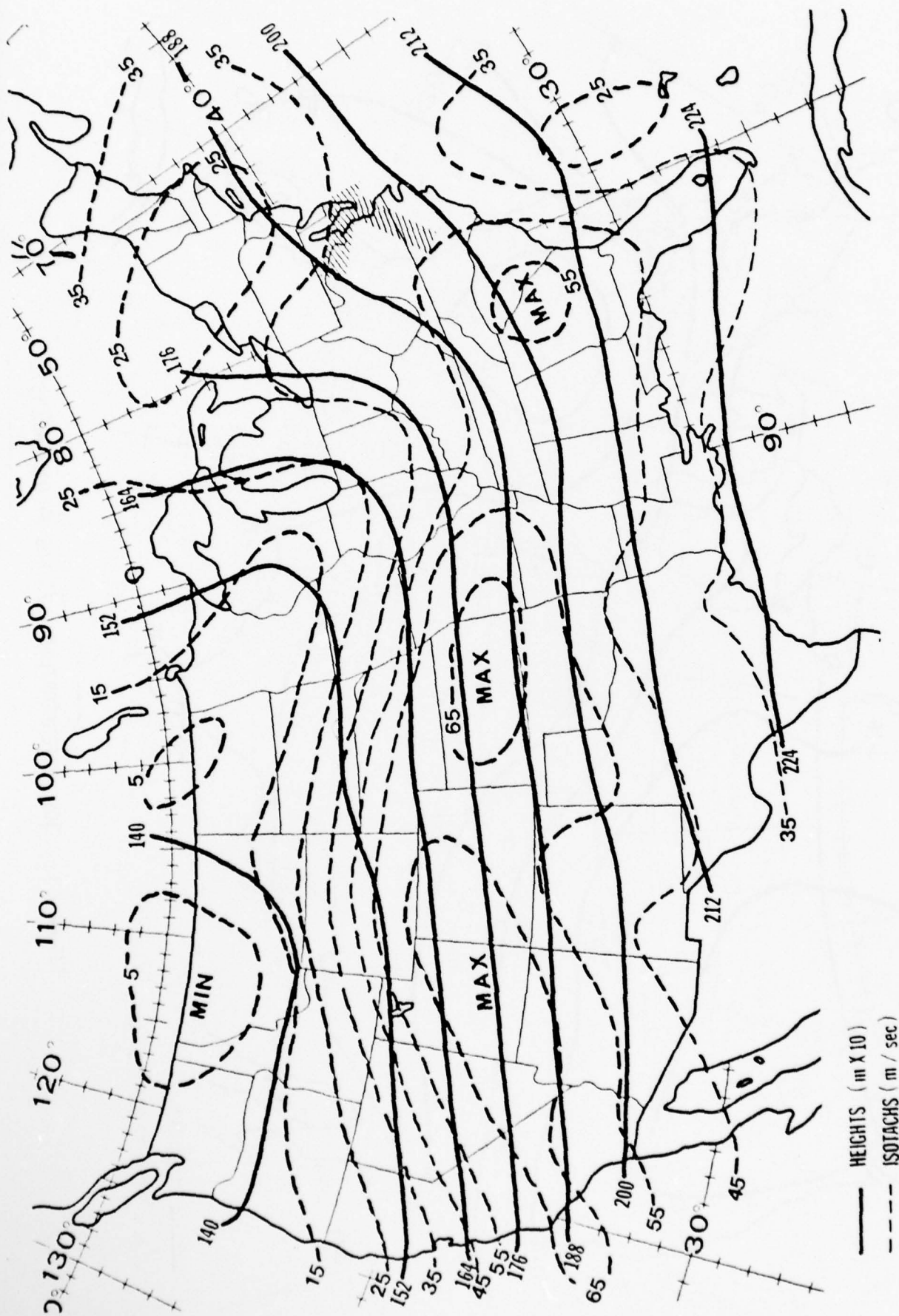


FIGURE 64. 200 mb HEIGHTS/ISOTACHS - 24 FEB 77 12Z ANALYSIS

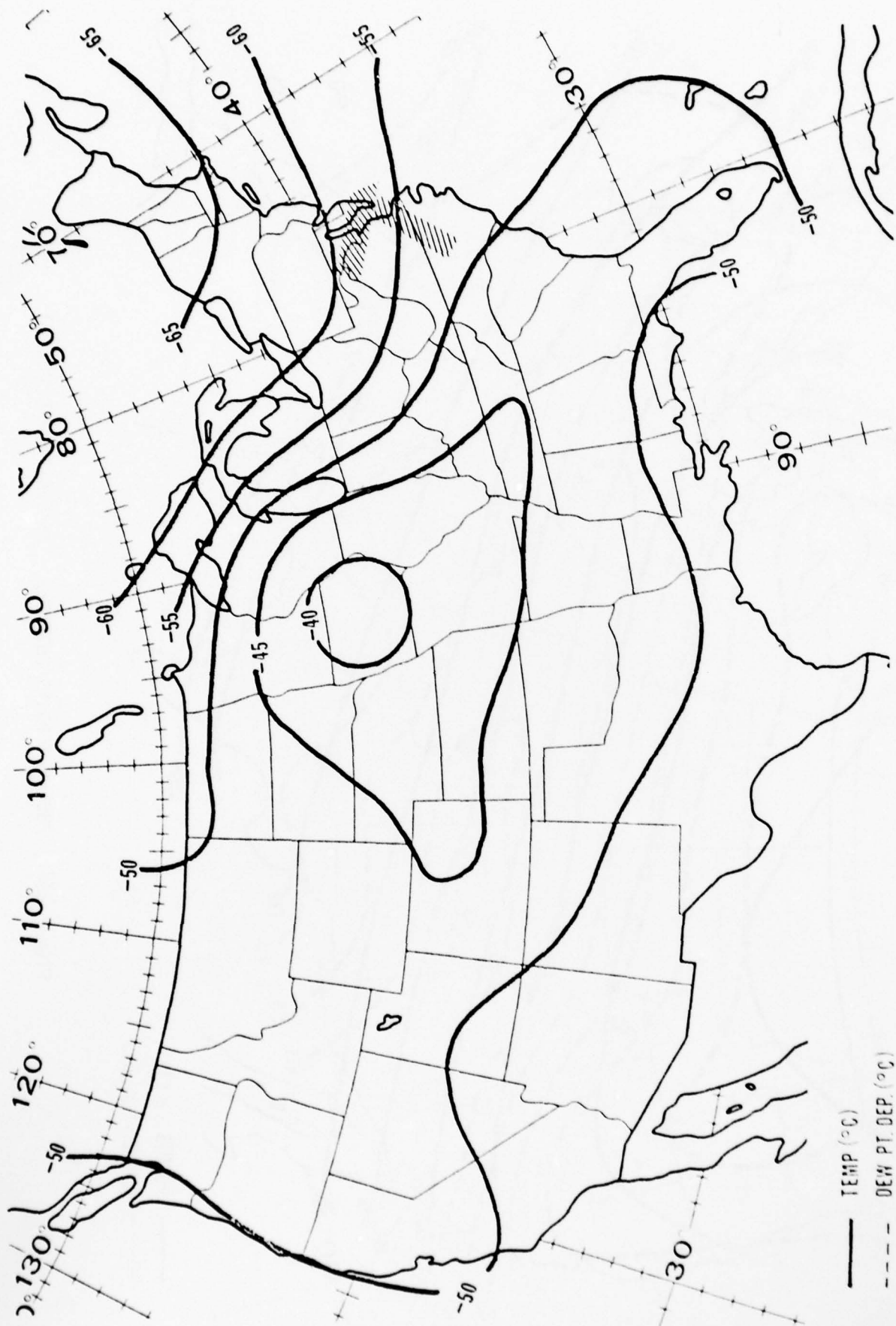


FIGURE 65. 200 mb TEMPERATURE - 24 FEB 77 12Z ANALYSIS

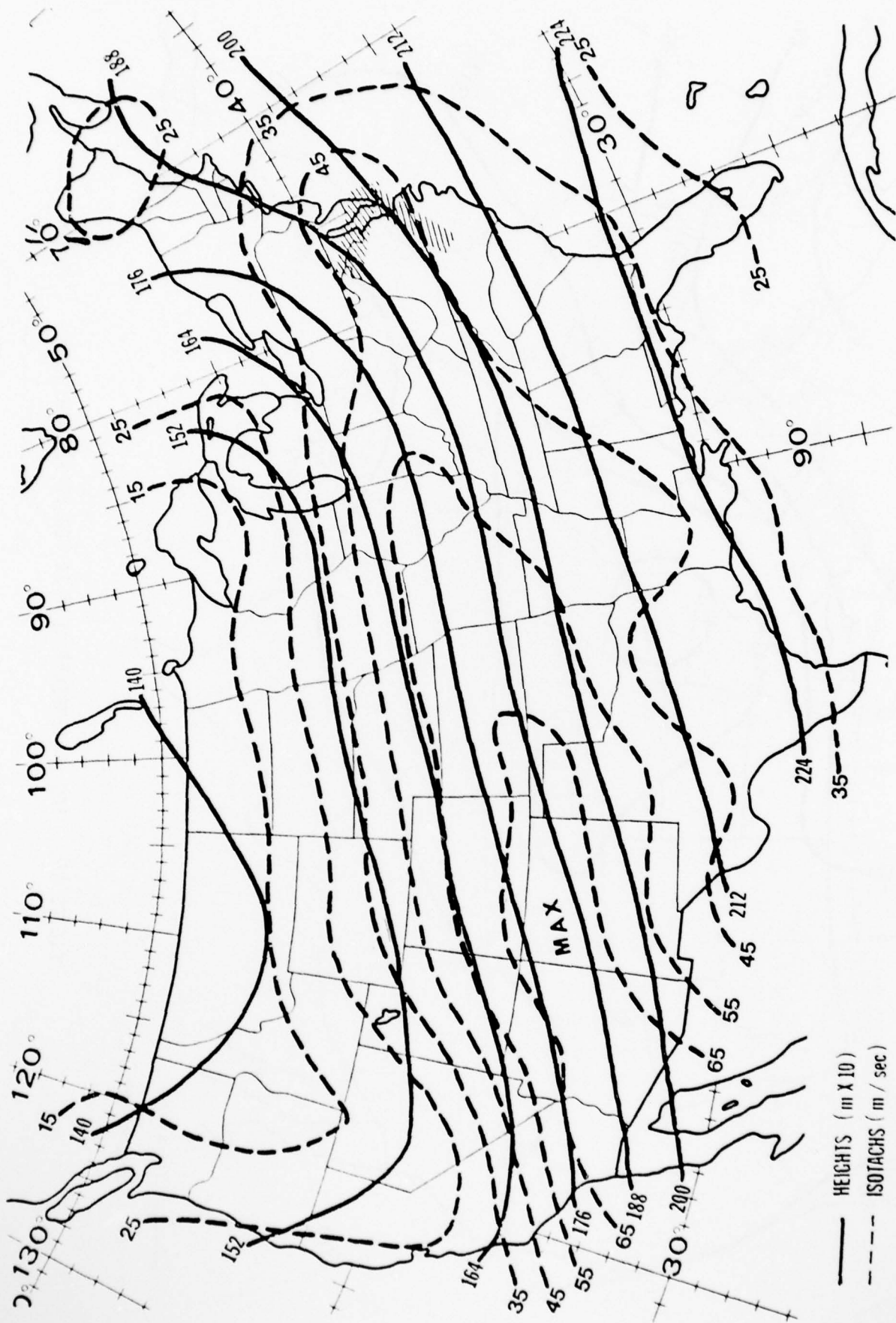


FIGURE 66. 200 mb HEIGHTS/ISOTACHS - 25 FEB 77 00Z ANALYSIS

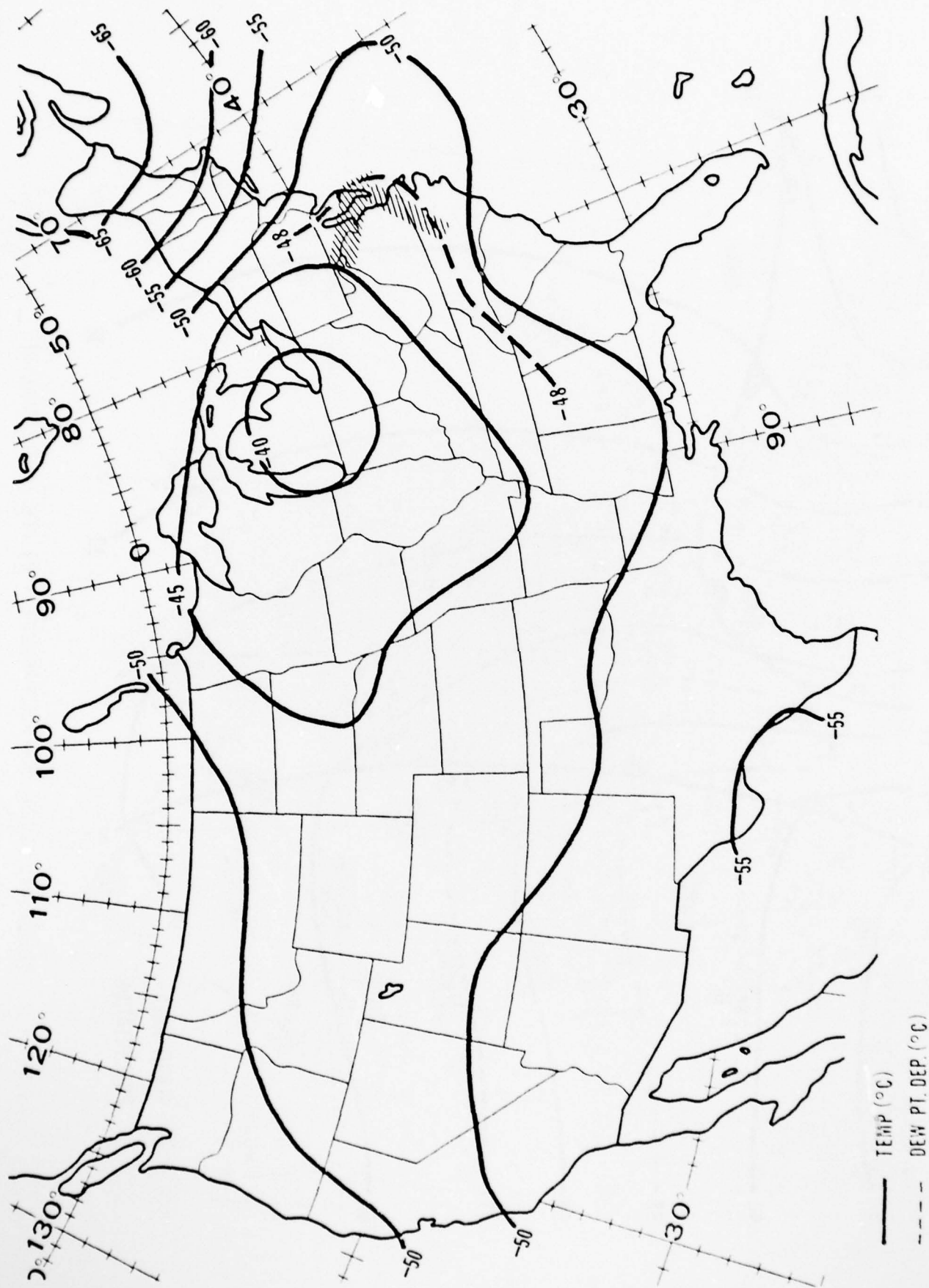


FIGURE 67. 200 mb TEMPERATURE - 25 FEB 77 00Z ANALYSIS

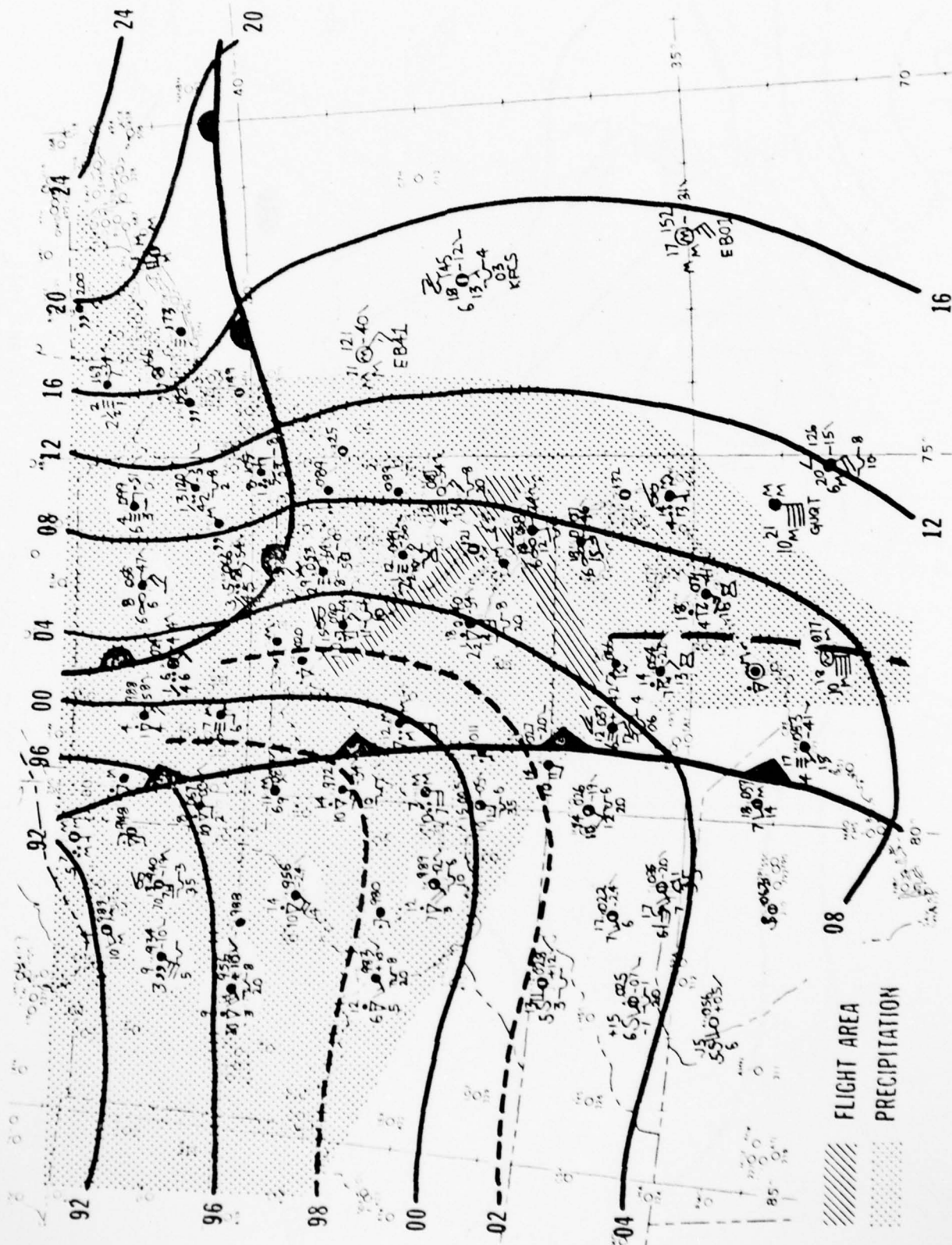


FIGURE 68. LOCAL SURFACE PRESSURE - 24 FEB 77 18Z ANALYSIS

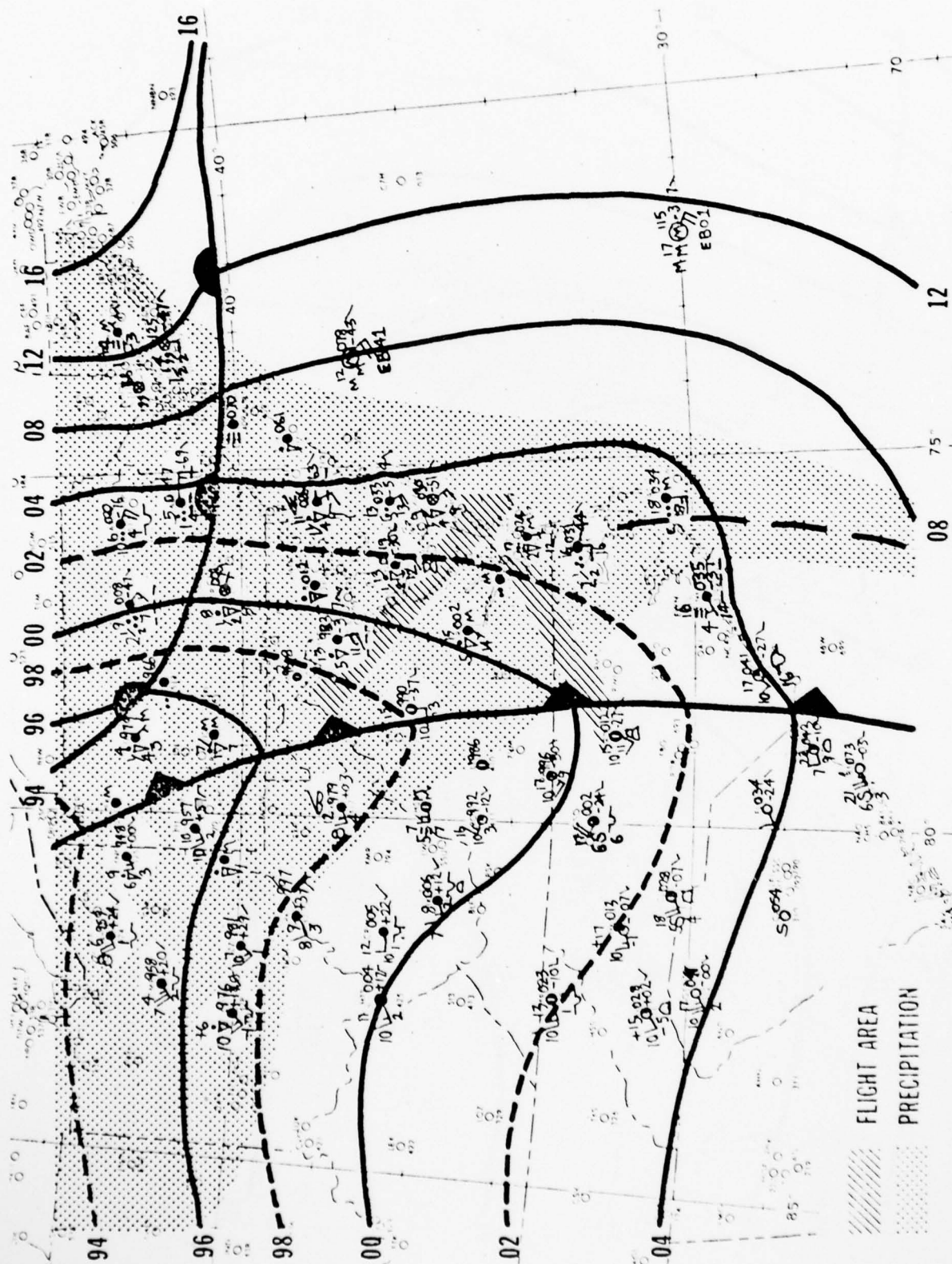


FIGURE 69. LOCAL SURFACE PRESSURE - 24 FEB 77 21Z ANALYSIS

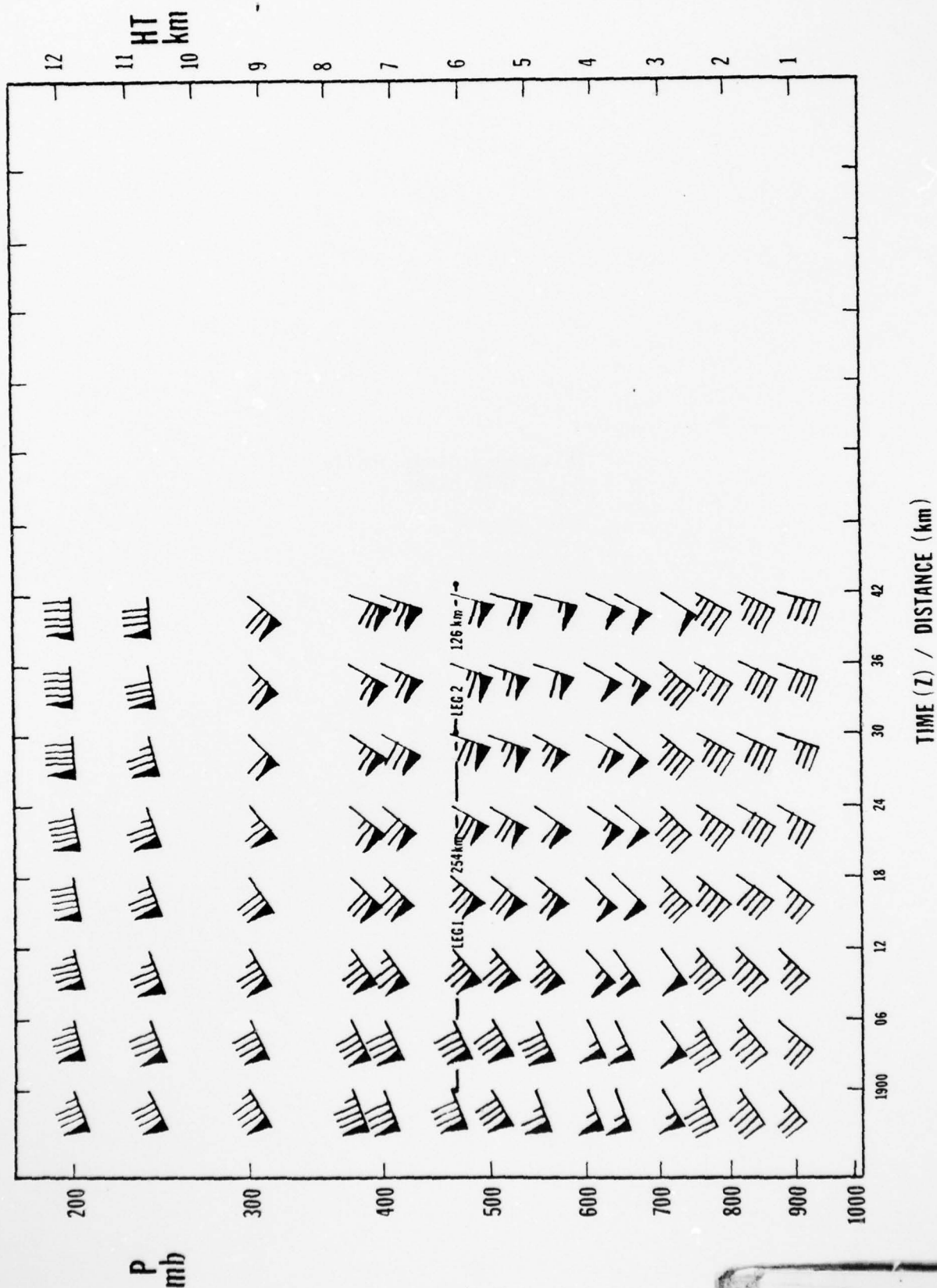


FIGURE 71. WIND CROSS-SECTION, LEGS 1 AND 2 - 24 FEB 77 ANALYSIS

AD-A066 981

SYSTEMS AND APPLIED SCIENCES CORP RIVERDALE MD
SYNOPTIC ANALYSIS CASE 3, 23 FEBRUARY 1977 - 25 FEBRUARY 1977.(U)
JAN 79 D CHIN, H D HAMILTON

F/6 4/2

F19628-78-C-0138

UNCLASSIFIED

SCIENTIFIC-3

AFGL-TR-79-0021

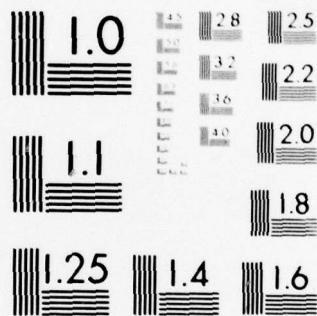
NL

2 OF 2

AD
A066981



END
DATE
FILMED
6-79
DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

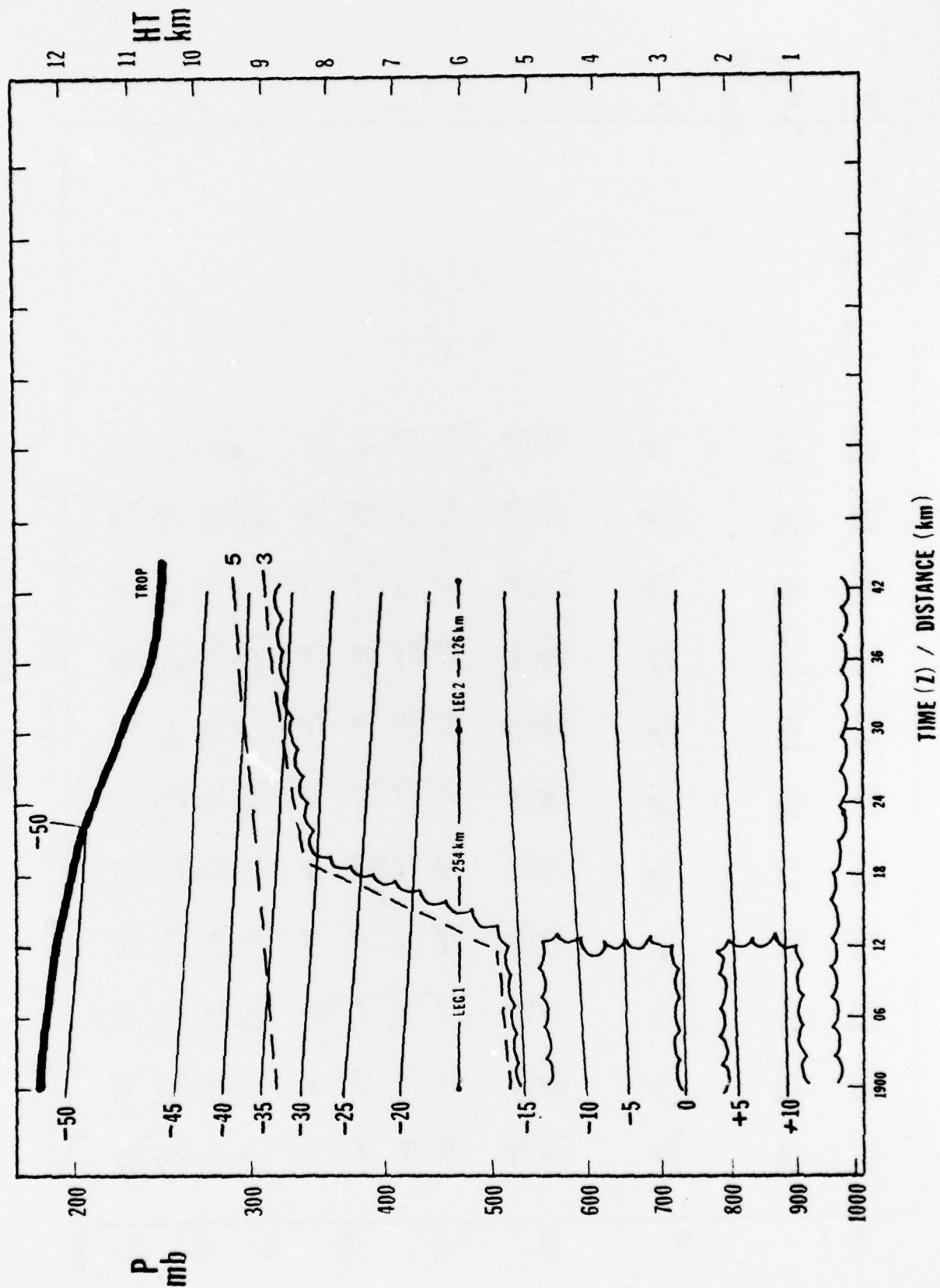


FIGURE 72. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEGS 1 AND 2 - 24 FEB 77 ANALYSIS

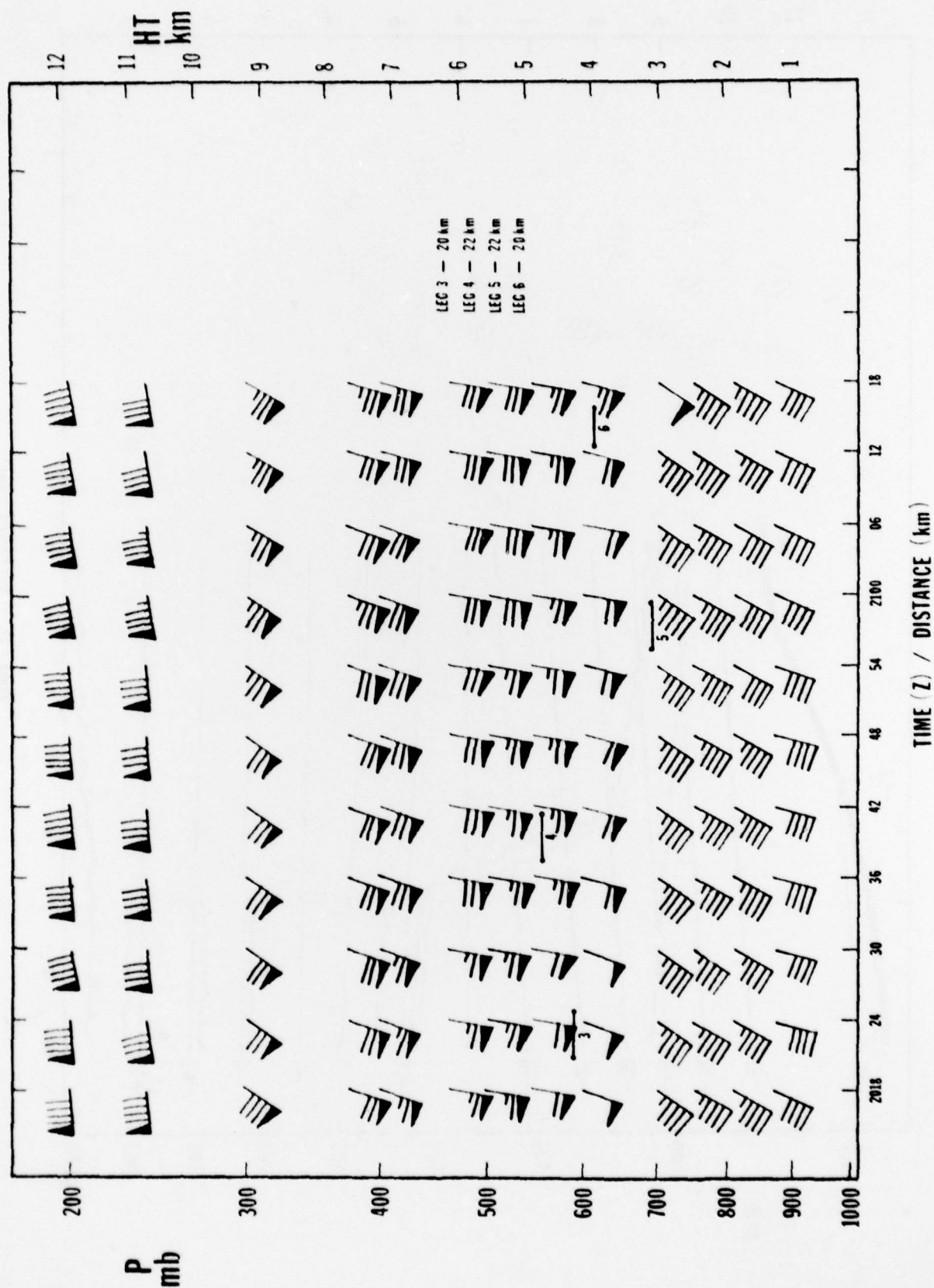


FIGURE 73. WIND CROSS-SECTION, LEGS 3, 4, 5, AND 6 - 24 FEB 77 ANALYSIS

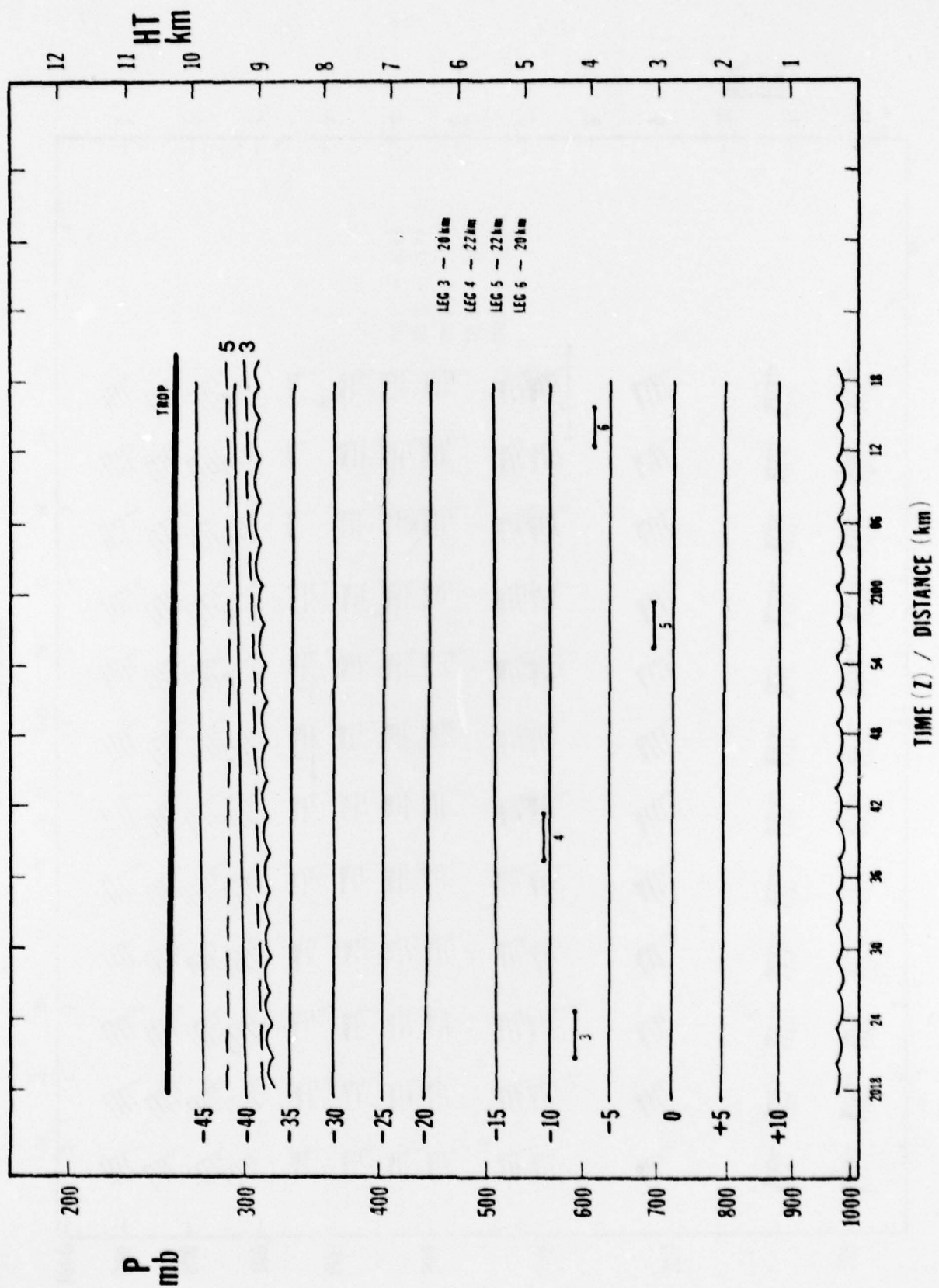


FIGURE 74. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEGS 3, 4, 5, AND 6 - 24 FEB 77 ANALYSIS

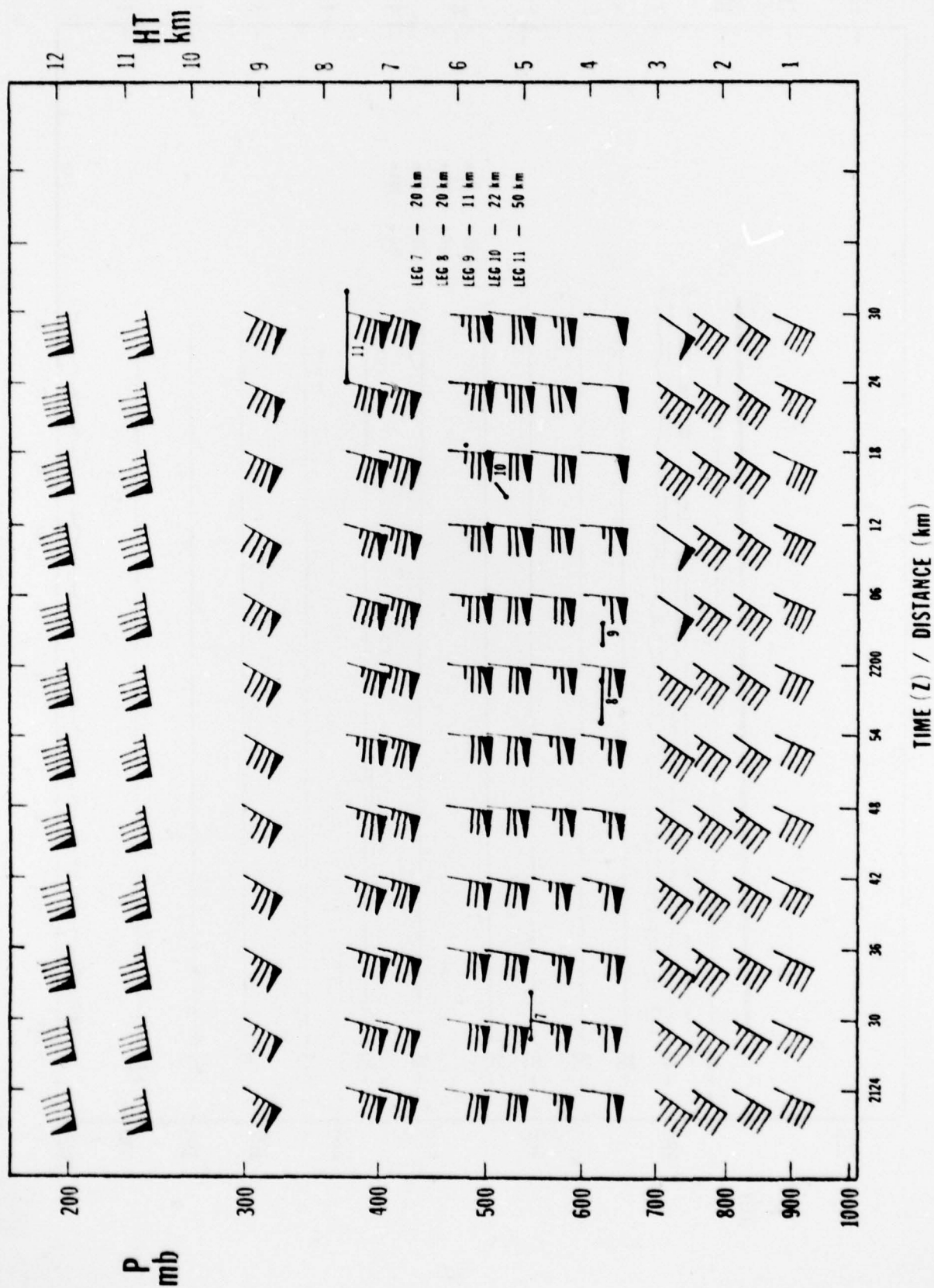


FIGURE 75. WIND CROSS-SECTION, LEGS 7, 8, 9, 10, AND 11 - 24 FEB 77 ANALYSIS

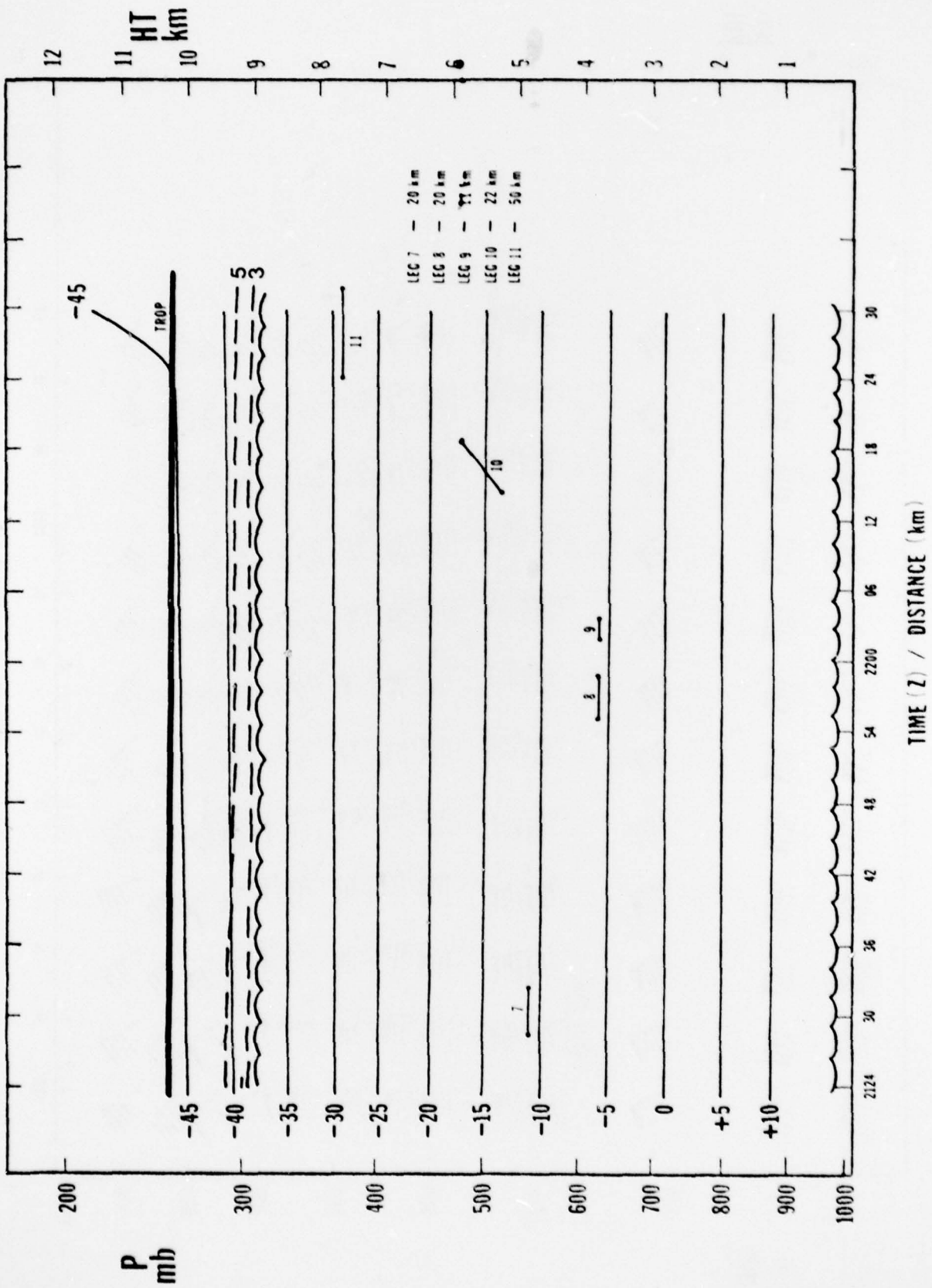


FIGURE 76. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEGS 7, 8, 9, 10, AND 11 - 24 FEB 77 ANALYSIS

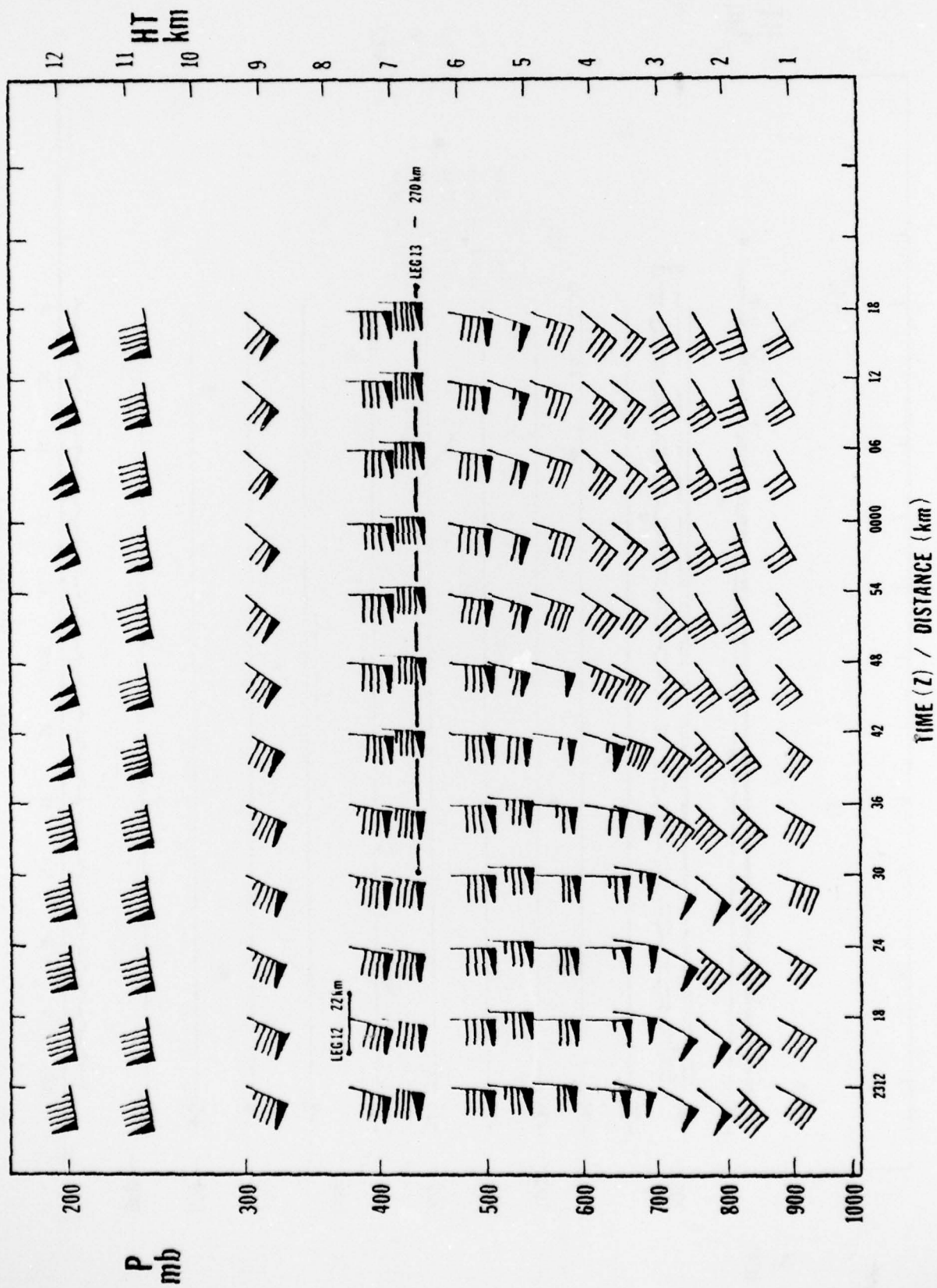


FIGURE 77. WIND CROSS-SECTION, LEGS 12 AND 13 - 24 FEB 77 ANALYSIS.

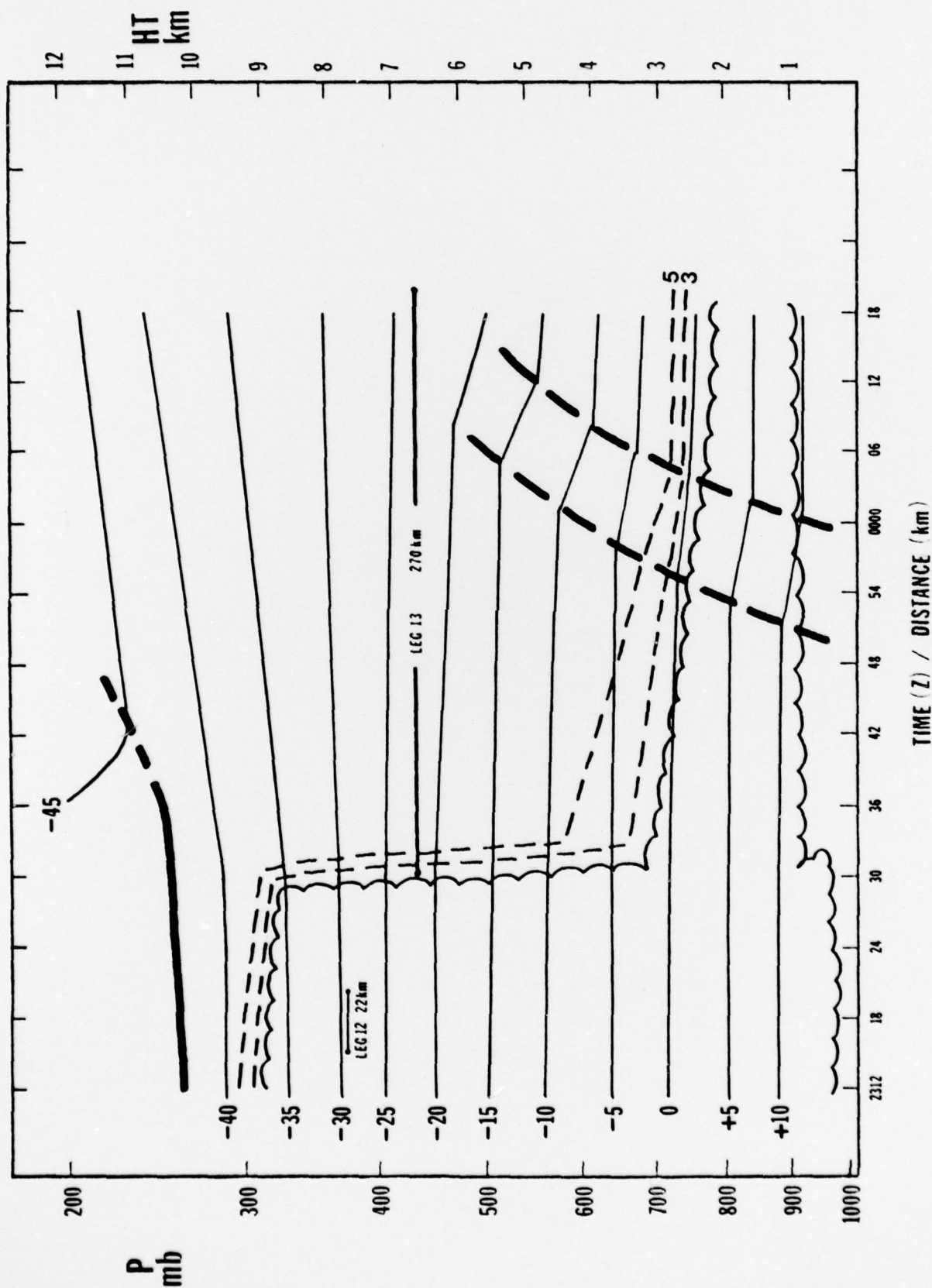


FIGURE 78. TEMP./DEW PT. DEPRESSION, CROSS-SECTION, LEGS 12 AND 13 - 24 FEB 77 ANALYSIS